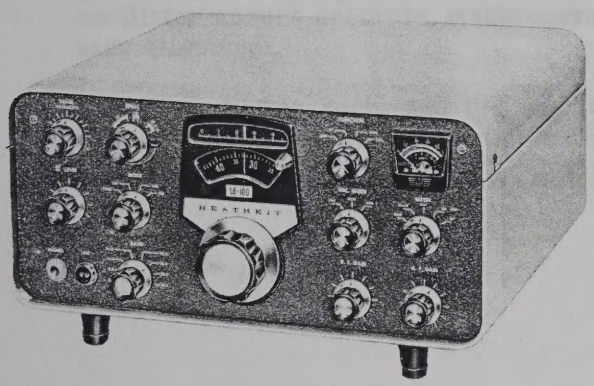
CONDENSED

Assembly and Operation of the HEATHKIT®

SSB TRANSCEIVER

MODEL SB-100



HEATH COMPANY,
BENTON HARBOR,
MICHIGAN

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INTRODUCTION

The Heathkit Model SB-100 Transceiver is a compact 80 through 10 meter transmitter and receiver. It is capable of SSB (single sideband with suppressed carrier) and CW (keyed continuous wave) operation. It may also be used as an exciter for a linear amplifier. Heathkit DC and AC power supplies are available for use with this Transceiver to provide both mobile and fixed-station operation.

Provisions are made for both VOX (voice-operated-transmit) and PTT (push-to-talk) operation. An anti-VOX circuit prevents the received signal, at the speaker, from switching the transmitter on during VOX operation. The preassembled, prealigned, linear master oscillator (LMO) and the crystal-controlled heterodyne oscillator assure accurate, stable operation with easy alignment.

The large tuning knob, and the smooth operation of the dial mechanism, provide convenient, backlash-free tuning. A built-in crystal calibrator allows the dial to be accurately calibrated at 100 kc intervals. Other features include: TALC™ (triple action level control) to prevent overdriving the final amplifiers; tone-actuated CW operation; and an S-meter that is switch-controlled in the transmit mode of operation to measure Grid Current, Plate Current, ALC Voltage, Relative Power, and High Voltage. A total of twenty tubes and sixteen diodes are used.

The use of circuit boards, Switch-Boards™, and wiring harnesses provide a clean, compact chassis layout and greatly simplifies kit assembly.

NOTE: Refer to the "Kit Builders Guide" for complete information on unpacking, parts identification, tools, wiring, soldering, and step-by-step assembly procedures.

START

RF-Driver Circuit Board-Continued

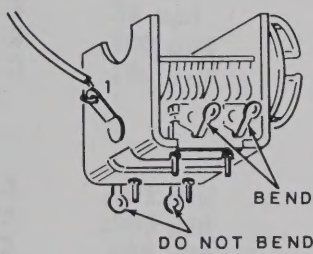
NOTE: Solder the connections of each part as it is installed. Do not cut off the lugs of these parts after soldering.

() Install 7-pin tube sockets at V6, V10, and V11.

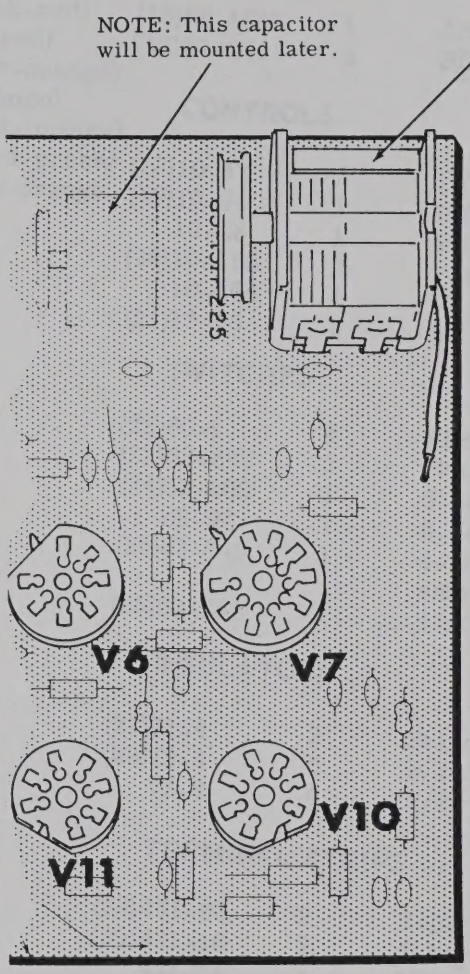
() Install a 9-pin tube socket at V7.

CAUTION: Keep the plates of variable capacitors closed at all times to prevent them from being damaged during the assembly of the kit.

() Locate a 2-section variable capacitors (#26-109). Bend both lugs, as shown, on the indicated side of the capacitor.

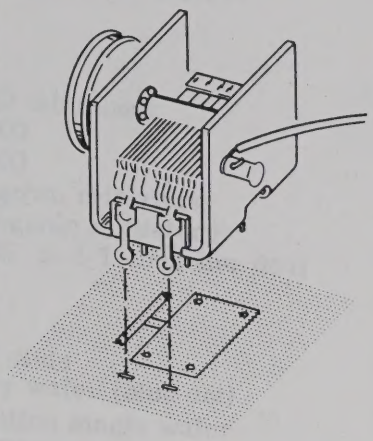


() Connect one end of a 2" wire to lug 1 of this capacitor (S-1). Use black hookup wire with 1/4" of insulation removed from both ends.



CONTINUE

() 2-section variable capacitor.



() Check to see that all connections are soldered.

FINISH

The remaining black hookup wire and sleeving should be retained for use later. All other parts selected at the beginning of this section of the Manual should have been used in the assembly of the circuit boards.

PICTORIAL 1-18

CHASSIS PARTS LIST

Unpack the remaining parts; then check each part against the following Parts List. The numbers in parentheses correspond to the numbers in the parts pictorials. Do not open small envelopes with part numbers on them until those parts are called for in steps.

PART No.	PARTS Per Kit	DESCRIPTION
RESISTORS		
1/2 Watt		
(1)1-41	6	10 Ω (brown-black-black)
1-3	1	100 Ω (brown-black-brown)
1-111	1	150 Ω (brown-green-brown)
1-45	1	220 Ω (red-red-brown)
1-4	1	330 Ω (orange-orange-brown)
1-96	1	750 Ω (violet-green-brown)

PART No.	PARTS Per Kit	DESCRIPTION
Resistors (cont'd.)		
1-9	1	1000 Ω (brown-black-red)
1-90	1	2000 Ω (red-black-red)
1-20	3	10 KΩ (brown-black-orange)
1-22	2	22 KΩ (red-red-orange)
1-25	1	47 KΩ (yellow-violet-orange)
1-37	1	2.2 megohm (red-red-green)
1-38	1	3.3 megohm (orange-orange-green)
1 Watt		
(2) 2A-30	1	1 megohm 1%
CAPACITORS		
Mica		
(3) 20-130	2	12 μμf
20-77	2	24 μμf
20-102	2	100 μμf
20-105	3	180 μμf
Disc		
(4) 21-14	3	.001 μfd
21-27	13	.005 μfd
21-44	2	.005 μfd 1.6 KV
21-16	1	.01 μfd
21-31	3	.02 μfd
Other Capacitors		
(5) 26-24	1	20 μμf variable
(6) 26-77	1	250 μμf variable
26-109	1	2-section variable
(7) 26-92	1	3-section variable
(8) 23-59	1	.05 μfd tubular
(9) 27-34	2	.2 μfd resin
COILS		
(10) 40-546	1	8.5 mc trap coil
(11) 40-549	1	10-meter coil
(12) 40-548	1	Final tank coil
CHOKES		
(13) 45-41	1	425 μh
(14) 45-30	1	.5 mh
(15) 45-53	2	Parasitic

PART No.	PARTS Per Kit	DESCRIPTION
DIODES		
(16) 56-M26	1	1N191 germanium
(17) 57-27	4	Silicon 750 ma 500 PIV
CONTROLS		
(18) 10-57	3	10 KΩ tab mount
(19) 10-44	1	100 KΩ
10-68	1	500 KΩ
(20) 10-153	2	1 megohm miniature
10-154	1	10 megohm miniature
(21) 12-48	1	10 KΩ and 1 megohm dual
SWITCHES		
(22) 60-1	1	SPST slide
(23) 63-395	1	Rotary wafer (blue dot)
(24) 63-400	1	3-position single wafer
63-94	1	5-position single wafer
(25) 63-349	1	4-position single wafer with snap switch
(26) 63-399	1	4-position double wafer
INSULATORS		
(27) 71-4	2	Standoff
(28) 73-4	5	5/16" rubber grommet
73-3	4	1/2" rubber grommet
TERMINAL STRIPS		
(29) 431-62	2	3-lug miniature
(30) 431-10	2	3-lug
431-11	1	5-lug
431-45	1	6-lug
CONNECTORS-JACKS-PLUGS		
(31) 432-38	1	Male connector
(32) 432-39	1	Female connector
(33) 436-4	1	3-lug jack
436-21	1	4-lug jack
(34) 438-4	8	Phono plug
(35) 438-29	1	11-pin plug
SOCKETS		
(36) 434-39	2	Octal
(37) 434-42	7	Phono
(38) 434-44	3	Pilot lamp
(39) 434-118	1	11-pin
(40) 434-143	2	Relay

PART No.	PARTS Per Kit	DESCRIPTION
SHIELDS		
(41) 206-77	1	Small tube, 1-3/4" long
206-68	1	Large tube, 1-3/4" long
206-206	1	Large tube, 2" long
(42) 206-86	3	Pilot lamp
TUBES-PILOT LAMPS		
411-59	1	OA2 tube
411-11	5	6AU6 tube
411-128	1	6BN8 tube
411-67	1	6CB6 tube
411-63	1	6CL6 tube
411-124	4	6EA8 tube
411-173	1	6GW8 tube
411-24	2	12AT7 tube
411-25	1	12AU7 tube
411-75	2	6146 tube
412-10	3	#47 pilot lamp
HARNESSES-WIRE-SLEEVING		
134-121	1	Wire harness
134-122	1	Coaxial cable harness
340-3	1	Small bare wire
340-2	1	Large bare wire
346-2	2	Large sleeving
343-7	1	Coaxial cable (RG-174/U)
344-51	1	Brown hookup wire
344-59	1	White hookup wire
344-21	1	Large red hookup wire
SHAFTS-BUSHINGS-SHAFT COUPLING		
(43) 453-108	1	8-1/4" long tubular shaft
(44) 453-17	1	9" long shaft
453-125	1	9-3/8" long shaft
453-136	1	11-1/4" long shaft
(45) 455-11	2	Split bushing
(46) 455-15	2	1/4" shaft collar
(47) 455-10	1	3/8" long bushing
455-18	2	9/16" long bushing
(48) 455-44	1	Nylon bushing
(49) 456-4	1	Shaft coupling
KNOBS		
(50) 462-175	1	7/16" diameter aluminum
(51) 462-191	10	1-1/8" diameter
(52) 462-193	1	2-1/2" diameter
(53) 462-195	1	Lever

PART No.	PARTS Per Kit	DESCRIPTION
DIAL PARTS		
(54) 258-1	3	Dial spring
349-1	1	Dial cord
(55) 446-40	1	Dial escutcheon
(56) 466-6	2	3/4" diameter pulley
(57) 100-M19	1	Dial pulley with 1/4" hole
100-M458	1	Dial pulley with 9/32" hole (red color dot)
#100-M450 Packaged Dial Drive Assembly, consisting of the following:		
(58) 204-553	1	Dial mounting bracket
(59) 100-443	1	Dial pointer assembly
(60) 464-30F949	1	Plastic dial window
(61) 100-M447	1	Dial pointer drive arm
(62) 250-63	1	3-48 x 1/8" screw
(63) 266-74	1	Nylon spiral follower
(64) 100-M445	1	Zero set drive pulley (small)
(65) 100-M449	1	Circular dial
(66) 100-M444	1	Dial drive pulley (large)
(67) 455-42	1	Drive shaft bushing package
METAL PARTS		
90-268	1	Cabinet
100-M554		RF cage consisting of the following:
(68)	1	RF cage rear plate
(69)	1	RF cage top plate
(70)	1	RF cage
(71) 204-M573	1	Capacitor bracket
(72) 204-M588F993	1	Control bracket
(73) 200-390F966	1	Chassis
(74) 203-M358F941	1	Front panel
(75) 204-M560	2	Support rail
(76) 204-M677	2	Comb bracket
(77) 206-M281	1	Final shield
(78) 206-M282	2	Switch shield
(79) 206-M280	1	Center shield
(80) 204-M590	2	Crystal filter bracket
(81) 204-M676	1	Front bracket
(82) 205-M493P230	1	Coil cover

TOOLS

PART No.	PARTS Per Kit	DESCRIPTION
(83) 490-1	1	Alignment
(84) 490-19	1	Open-end wrench
(85) 490-23	1	#4 allen wrench
490-85	1	#8 allen wrench

HARDWARE

#3 Hardware

(86) 250-172	82	3-48 x 3/8" screw
(87) 250-251	2	3-48 x 3/8" flat head screw
(88) 252-1	84	3-48 nut
(89) 254-7	164	#3 lockwasher
(90) 258-5	10	#3 spring clip

#6 Hardware

(91) 250-56	7	6-32 x 1/4" screw
(92) 250-89	37	6-32 x 3/8" screw
(93) 250-276	8	6-32 x 3/8" flat head screw
(94) 250-218	2	6-32 x 3/8" Phillips head screw
(95) 250-284	20	#6 x 1/2" sheet metal screw
(96) 250-26	4	6-32 x 5/8" screw
(97) 250-40	2	6-32 x 1-1/2" screw
(98) 252-3	52	6-32 nut
(99) 253-1	2	#6 fiber flat washer
(100) 253-2	3	#6 fiber shoulder washer
253-60	4	#6 flat washer
(101) 254-1	68	#6 lockwasher
(102) 259-6	1	Small #6 solder lug
(103) 259-1	3	Large #6 solder lug

#8 Hardware

(104) 250-93	19	#8 x 1/4" setscrew
(105) 250-260	2	8-32 x 1/4" screw
(106) 250-72	1	8-32 x 3/4" screw
(107) 252-4	1	8-32 nut
(108) 252-28	1	8-32 knurled nut
(109) 253-45	2	#8 flat washer
(110) 254-2	1	#8 lockwasher
(111) 259-2	1	#8 solder lug

1/4" Control Hardware

(112) 252-39	3	1/4-32 nut
(113) 253-11	1	E washer
(114) 253-36	1	1/4" dished washer
(115) 253-39	3	1/4" flat washer
253-49	1	1/4" nylon flat washer
(116) 75-18	1	1/4" nylon shoulder washer
(117) 253-62	2	1/4" fiber flat washer
(118) 259-12	4	1/4" solder lug

3/8" Control Hardware

(119) 252-7	14	3/8-32 nut
(120) 253-10	13	3/8" flat washer
(121) 254-5	5	3/8" lockwasher
(122) 259-10	6	3/8" solder lug

Other Hardware

(123) 250-156	1	4-40 x 1/8" setscrew
(124) 207-22	1	Cable clamp
(125) 260-39	2	Anode clip
(126) 435-1	1	11-pin plug retaining ring
(127) 435-10	2	Relay socket retaining ring

MISCELLANEOUS

(128) 51-123	1	Output transformer
(129) 69-35	2	4PDT relay
74-6	2	Masking tape
110-32	1	LMO (linear master oscillator)
(130) 255-59	2	Foot spacer
(131) 261-9	4	Rubber feet
(132) 266-85	1	Rotary switch detent
390-147	1	High voltage label
391-28	1	SB-100 nameplate
(133) 404-200	1	3395 kc crystal filter
407-101	1	Meter
(134) 440-1	1	11-pin socket cap

CONTROL FUNCTIONS

The functions of the front panel and chassis controls are outlined in this section. Read the following paragraphs carefully, so you will be familiar with the operation of each control before starting to check, align, or operate this Transceiver.

FRONT PANEL FUNCTIONS

Driver Preselector

This control is used to peak the receiver RF amplifier and transmitter driver tuned circuits. The adjustment can be made in either the receive or transmit mode of operation, and must be adjusted at each position of the BAND switch. This adjustment should also be made when the operating frequency is changed appreciably.

Mic/CW Level

When the MODE switch is in the LSB or USB position, this control is used to adjust the audio drive. The control has range enough to adjust for most high level crystal microphones or dynamic microphones.

With the MODE switch in the Tune or CW position, the carrier output level of the transmitter is adjusted with this control.

Phones

High impedance headphones can be connected to this jack. When the headphone plug is inserted, the speaker is disconnected from the circuit.

Mic (Microphone)

A high-impedance microphone should be connected to this socket. Provisions are made in the socket for connecting a microphone with a push-to-talk switch.

Final

The round knob is the FINAL tuning control, and the panel markings are for the 80-meter through 10-meter bands. After the Main Tuning control has been set to the desired operating frequency, and the MODE switch set to the TUNE position, this control is adjusted for maximum (Relative Power) meter indication to tune the transmitter for maximum output.

The lever arm is the FINAL loading control. It is also tuned for a maximum (Relative Power) meter indication. At this point, there is a proper impedance match between the final amplifier circuit and the antenna.

The FINAL Tuning and FINAL loading controls have some interaction and must be adjusted alternately until maximum relative power is achieved.

Mode

This switch selects the LSB, USB, or CW mode of operation for the receive and transmit sections. In the TUNE position, the transmitter is turned on so the driver and final RF stage can be tuned.

Band

In the first four switch positions, this switch selects the following bands: 80-meter (3.5 mc to 4.0 mc), 40-meter (7.0 mc to 7.5 mc), 20-meter (14.0 mc to 14.5 mc), and 15-meter (21.0 mc to 21.5 mc).

The following 500 kc portions of the 10-meter band are selected in the other four positions of this switch: 28.0 mc to 28.5 mc, 28.5 mc to 29.0 mc, 29.0 mc to 29.5 mc, and 29.5 mc to 30.0 mc.

Main Tuning

The Main Tuning (LMO) has two dials; the lower (circular) and upper (straight) dials.

The lower or circular dial is divided into one-hundred 1 kc segments. The upper or straight dial is numbered from 0 to 5, and is divided into five 100 kc segments. The distance between any two consecutive numbers is equal to 100 kc, or one revolution of the circular dial. Each large segment is divided into two 50 kc segments, each equal to one-half of a revolution of the circular dial.

The frequency setting of the Main Tuning dial is determined by adding three numbers together as follows: the BAND switch setting in megacycles, the upper dial setting in hundreds of kilocycles, and the circular dial setting in kilocycles.

Example #1

BAND switch set at 7.0	7.0 mc
Upper dial pointer between 2 and 3	200 kc
Circular dial pointer at 26	26 kc
Transceiver frequency	7.226 mc

Example #2

BAND switch set at 28.5	28.5 mc
Upper dial pointer between 3 and 4	300 kc
Circular dial pointer at 74	74 kc
	28.874 mc

Zero Set Dial

This control adjusts the position of the zero set line when the dial is calibrated. First, the Main Tuning control is adjusted for a zero beat with the 100 kc calibrate signal. Then the Zero Set knob is turned until the zero set line is over the zero mark on the circular dial. The Zero Set Dial should be adjusted at each new setting of the BAND switch. NOTE: On the higher bands, extra signals may be heard in the CAL position. The correct ones should be quite near "0", and can be peaked with the DRIVER PRESELECTOR.

Function

This switch turns the Transceiver OFF, or turns it on when set at the PTT (push-to-talk), VOX (voice-operated-transmit), or CAL (calibrate) positions.

In the PTT position, the Transceiver is changed from receive to transmit operation by using a push-to-talk microphone switch, or a CW key. The MODE switch must be set at LSB or USB for push-to-talk operation, or at CW when using a CW key.

In the VOX position, the Transceiver is changed from receive to transmit operation when the operator talks into the microphone, or when the CW key is depressed (depending on the MODE switch position).

In the CAL position, the 100 kc crystal oscillator signal is turned on to calibrate the Main Tuning dial at 100 kc intervals.

OSC Mode

At the LMO position of this switch, the receiver and transmitter operating frequencies are determined by the linear master oscillator. The linear master oscillator frequency is determined by the setting of the Main Tuning control.

In the XTAL position, the auxiliary crystal and crystal oscillator tube V5B determine the receiver and transmitter operating frequency.

In the AUX T position, the auxiliary crystal and crystal oscillator tube V5B determine only the transmitter frequency. The receiver frequency is set with the Main Tuning (LMO) control.

RF Gain

The receiver sensitivity is controlled by the RF GAIN control. This control is set at the full clockwise position for maximum gain.

Meter

In the receive mode of operation, the METER switch is normally set at the ALC position. Then the meter is connected as an S-Meter that reads from 0 to 60 db over S-9.

In the transmit mode of operation, the METER switch selects one of the following five measurements to be read on the meter: final amplifier Grid current (0 to 1 ma), final amplifier Plate current (0 to 500 ma), Automatic Level Control, Relative (output) Power, and High Voltage on the B+ line (0 to 1000 volts DC).

AF Gain

The AF GAIN control adjusts the audio output in the receive mode of operation.

CHASSIS FUNCTIONS

VOX Sen

The VOX SENsitivity control adjusts the VOX relay circuit to operate at the voice level desired by the operator. When the operator talks into the microphone, the VOX relay is energized and places the transmitter "on-the-air."

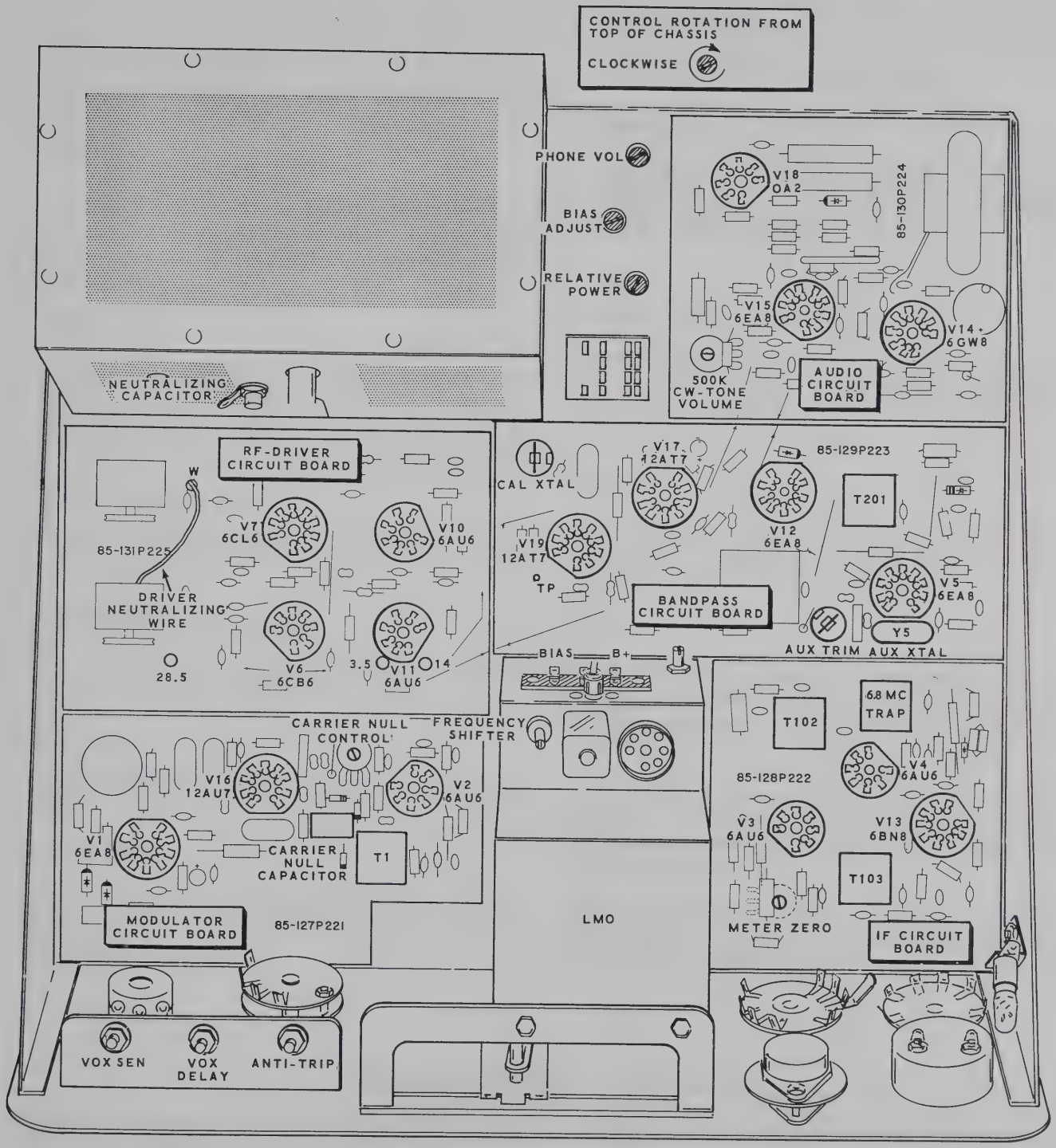

CONTROL ROTATION FROM TOP OF CHASSIS
CLOCKWISE
PHONE VOL
BIAS ADJUST
RELATIVE POWER
NEUTRALIZING CAPACITOR
V18 OA2
85-130P224
V15 6EA8
V14 6GW8
500K CW-TONE VOLUME
AUDIO CIRCUIT BOARD
RF-DRIVER CIRCUIT BOARD
W
85-131P225
V7 6CL6
V10 6AU6
DRIVER NEUTRALIZING WIRE
28.5
V6 6CB6
3.5
V11 6AU6
14
CAL XTAL
V17 12AT7
85-129P223
T201
V19 12AT7
TP
V12 6EA8
V5 6EA8
BANDPASS CIRCUIT BOARD
Y5
AUX TRIM AUX XTAL
BIAS
B+
CARRIER NULL CONTROL
FREQUENCY SHIFTER
T102
6.8 MC TRAP
V4 6AU6
85-128P222
V16 12AU7
V2 6AU6
V1 6EA8
CARRIER NULL CAPACITOR
T1
V3 6AU6
V13 6BN8
T103
METER ZERO
MODULATOR CIRCUIT BOARD
85-127P221
LMO
IF CIRCUIT BOARD
VOX SEN
VOX DELAY
ANTI-TRIP

FIGURE 1-1

VOX Delay

This control adjusts the length of time the transmitter stays on after the operator stops talking (when the FUNCTION switch is set at VOX). Proper setting of the VOX DELAY control eliminates repeated keying of the transmitter at the beginning of each word.

Anti-Trip

The ANTI-TRIP control adjusts the VOX circuit to keep the received signal (at the speaker) from turning on the transmitter by feedback into the microphone.

Meter Zero

The METER ZERO control is adjusted for a zero reading on the meter in the receive mode of operation with no signal being received and with the RF GAIN control turned fully clockwise.

Carrier Null Control

This control balances the modulator to suppress the carrier.

Carrier Null Capacitor

The CARRIER NULL CAPACITOR is adjusted to complete the modulator balance.

Cal Xtal

This trimmer adjusts the 100 kc oscillator to exactly 100 kc.

Aux Trim

This trimmer permits the frequency of the auxiliary crystal oscillator to be adjusted a small amount.

CW-Tone Volume

With the MODE switch set to CW and with the CW key depressed, the CW-TONE VOLUME control adjusts the CW tone to the desired monitoring level from the speaker.

Phone VOL

The PHONE VOLUME control is adjusted to obtain the desired balance between the speaker and headphone levels.

Bias Adjust

This control adjusts the bias voltage on the final RF amplifier tubes when the MIC/CW LEVEL control is turned fully counterclockwise.

Relative Power

The Relative Power control adjusts the meter sensitivity when the METER switch is in the REL PWR position.

Antenna

In the COMmon position, the built-in antenna relay switches the common receiving and transmitting antenna from the receiver to the transmitter sections.

In the RECeiver position, the receiver antenna circuit is connected to the RECeiver ANTenna jack when separate receiving and transmitting antennas are used.

Also, this switch makes it possible to use this Transceiver with a linear amplifier that does not have a built-in antenna change-over relay.

PRELIMINARY CHECKS

Before applying power to the Transceiver, complete the preliminary checks as outlined in this section. These checks are needed to be sure there are no short circuits or open connections that would cause damage to the Transceiver components.

() Check the position of the pointer on the panel meter. If necessary, adjust the screw at the front of the meter until the pointer is on zero.

() Turn the following front panel controls to a fully counterclockwise position.

DRIVER PRESELECTOR control
MIC/CW LEVEL control
MODE switch
BAND switch
FUNCTION switch
OSC MODE switch
RF GAIN control
METER switch
AF GAIN control

() Set the following chassis controls to a fully counterclockwise position. Refer to Figure 1-1 (fold-out from Page 80) to help locate the controls.

VOX SEN
VOX DELAY
ANTI-TRIP
CARRIER NULL control
METER ZERO
CW-TONE VOLUME
PHONE VOL
BIAS ADJUST
RELATIVE POWER

() At the rear of the chassis, push the ANTENNA switch to the REC position.

METER CIRCUIT CHECKS

Refer to Figure 1-2 (fold-out from Page 97) to locate the test points for the following checks.

An ohmmeter will be used for the following checks. When making the first check, the polarity of the ohmmeter test leads will be determined. Then the test points for the common and positive (+) leads will be called out in each step.

() Set the ohmmeter to the RX1 range.

() Turn the front panel METER switch to the PLATE position.

() Check the polarity of the ohmmeter leads as follows: Connect one ohmmeter lead to the Transceiver chassis and the other lead to pin 1 of tube socket V9. If an "up scale" deflection of the panel meter is not obtained, reverse the ohmmeter leads. When an "up scale" meter indication is obtained, the meter lead connected to pin 1 of tube socket V9 should be marked (+) positive. This lead should be used as the positive (+) lead for the remaining checks.

NOTE: If the correct results are not obtained in the following steps, refer to the In Case Of Difficulty section on Page 110. It is suggested that all the checks be completed before doing any troubleshooting. The resistance reading may set some pattern that will make the difficulty easier to locate.

Complete each of the following checks by connecting the ohmmeter leads as indicated. Set the METER switch and the ohmmeter range as listed in the step. For each check, the panel meter should indicate in an "up scale" direction.

METER SWITCH	OHMMETER RANGE	COMMON LEAD	POSITIVE (+) LEAD
() GRID	RX10	Pin 5 of tube socket V9	Chassis
() ALC	RX1	Pin 7 of tube socket V3 (on IF circuit board)	Chassis
() REL PWR	RX1	Chassis	Lug 1 of terminal strip BH
() HV	RX100	Chassis	Lug 1 of terminal strip BK

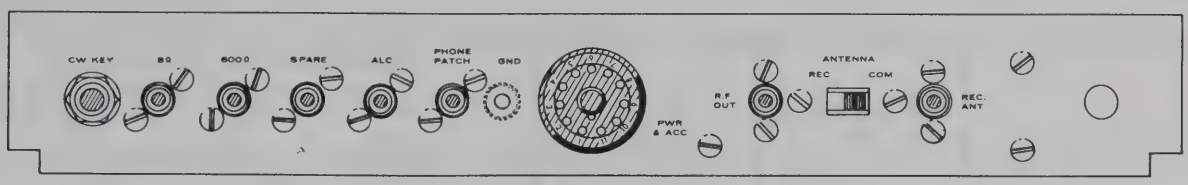


Figure 1-3

RESISTANCE CHECKS

Refer to Figures 1-1 (fold-out from Page 80), 1-2 (fold-out from Page 97), and 1-3 for the following resistance checks.

Complete the resistance checks listed in each of the three charts. Connect the common and positive (+) ohmmeter leads and set the switches as listed in the chart.

When more than one switch setting is given, make the resistance check at each setting of the switch. Also, observe the special instructions given in the NOTES column.

NOTE: If any incorrect resistance readings (± 20% from the listed value) are obtained, refer to the In Case Of Difficulty section and correct the trouble before proceeding.

NOTE: The word "Diode" in the NOTES column of the following charts indicate that a diode is in the circuit under test. Therefore, the measured resistance can vary due to the forward current of the diode, and depending on the range setting of the ohmmeter.

OHMMETER TEST POINTS		MODE SWITCH	RESISTANCE IN OHMS	NOTES
COMMON LEAD	POSITIVE (+) LEAD			
() Chassis	CW KEY jack, lug 3	CW	50K	
() CW KEY jack, lug 3	Chassis	"	30K	(Diode)
() "	"	TUNE, LSB, and USB	50K	(Diode)
() Chassis	8 Ω jack, lug 2	TUNE	.7	
() "	600 Ω jack, lug 2	"	3 to 20	
() "	Spare jack, lug 2	"	INF	
() "	ALC jack, lug 2	"	5 to 20	(Diode)
() ALC jack, lug 2	Chassis	TUNE and CW	10K to 500	(Diode) Varies with setting of MIC/ CW LEVEL control.
() "	"	LSB and USB	1M to 3M	(Diode)
() Chassis	Phone Patch jack, lug 2	TUNE	1.3M	
() "	Power plug Pin 1	"	13K	
() "	" Pin 2	"	0	

OHMMETER TEST POINTS		MODE SWITCH	RESISTANCE IN OHMS	NOTES
COMMON LEAD	POSITIVE (+) LEAD			
() Chassis	Power plug, Pin 3	TUNE, LSB, USB, CW	35K	
() "	Power plug, Pin 4	TUNE	1M	
() "	" Pin 5	"	INF	
() "	" Pin 6	"	1	
() "	" Pin 7	"	0	
() "	" Pin 8	"	INF	
() "	" Pin 9	"	INF	
() "	" Pin 10	"	INF	
() "	" Pin 11	"	INF	
() Power Plug, Pin 9	" Pin 10	"	INF	
() " "	" "	"	0	Check at three positions of FUNCTION switch: PTT, VOX and CAL. Then return the FUNCTION switch to the OFF position.
() Chassis	RF OUT jack, lug 2	"	INF	
() "	"	"	.2	Check with ANT switch at COM.
() "	REC ANT jack, lug 1	"	.2	
() "	PHONES jack, contact 5	"	0 to 2500 to 0	Varies with setting of PHONE VOL control.
() "	MIC socket, lug 1	"	1M	
() "	" lug 2	"	0	
() "	" "	LSB, USB, and CW	500K	
() "	RF GAIN control, lug 2	TUNE	70K to 10	Varies with setting of RF GAIN control.
() "	AF GAIN control, lug 2	"	0 to 500K	Varies with setting of AF GAIN control.

OHMMETER TEST POINTS		BAND SWITCH	RESISTANCE IN OHMS
COMMON LEAD	POSITIVE (+) LEAD		
() Chassis	Capacitor lug DB-1	3.5 and 7.0	11K
() "	" " "	14.0 through 29.5	INF
() Power Plug, Pin 3	CIRCUIT BOARD LOCATION RF DRIVER Foil 7	3.5	1
() "	" 3	"	1
() "	" 3	7.0 through 29.5	22K
() "	" 9	3.5	1000
() "	" 4	"	1000
() "	" 4	7.0 through 29.5	INF
() Chassis	Lug 1 (Wafer BS1 of BAND switch)	3.5	4700
() "	"	7.0 through 29.5	INF
() "	Audio 22 Circuit Board	3.5	35K
() Audio Circuit Board 22	Bandpass Circuit Board B	All Positions	100



OHMMETER TEST POINTS		MODE SWITCH	OSC MODE SWITCH	RESISTANCE IN OHMS	NOTES
COMMON LEAD	POSITIVE (+) LEAD				
() Chassis	CIRCUIT BOARD LOC. Bandpass H	TUNE	LMO and AUX T	.3	
() "	" H	"	XTAL	INF	
() "	" F	"	LMO	220	
() "	" F	"	XTAL and AUX T	INF	
() "	" G	"	LMO	INF	
() "	" J	"	"	150K	
() Audio Circuit Board 22	" 19	"	LMO and AUX T	INF	
() " 22	" 19	"	XTAL	0	
() " 22	B+ (terminal board at rear of LMO)	"	"	INF	
() " 22	"	"	LMO and AUX T	0	
() Chassis	CIRCUIT BOARD LOC. Bandpass E	"	LMO	35K	
() "	" 8	"	"	100K to 600K	Varies with setting of VOX SEN control.
() "	" 8	CW	"	0	
() "	" D	TUNE, USB, LSB	"	0 to 500K	Varies with setting of VOX SEN control.
() "	" "	CW	"	0 to 100K	"
() "	" 10	"	"	350K to 500K	Varies with setting of ANTI-TRIP control. (Diode)

COIL COVER INSTALLATION

Refer to Pictorial 3-25 for the following steps.

() Install the eight spring clips on the coil cover with 3-48 x 3/8" hardware. Position the spring clips as shown. Bend the clip ends down slightly as shown in the inset drawing.

CAUTION: Be sure that none of the lugs of the switch wafers that are mounted on the driver plate, driver grid, heterodyne oscillator, and crystal circuit boards extend beyond the edges of these circuit boards.

() Refer to Detail 3-25A and mount the coil cover on the bottom of the chassis with #6 x 3/8" sheet metal screws (screws from the RF cage). Be sure the spring clips on the coil cover fit on each side of the two switch shields. Note that the edge of the coil cover must first be positioned under the support rail, before the coil cover can be positioned into place. This can be checked by looking at the ends of the circuit boards from under the support rail.

() Check the resistance between pin 3 of the power plug and the chassis. A zero resistance reading indicates a short circuit caused by the coil cover touching one or more of the switch lugs. This condition must be corrected before turning on the Transceiver.

TUBE INSTALLATION

() Replace the 6BZ6 tube and tube shield that were removed previously from the LMO.

() Install the remaining tubes in their sockets, as identified on the circuit boards.

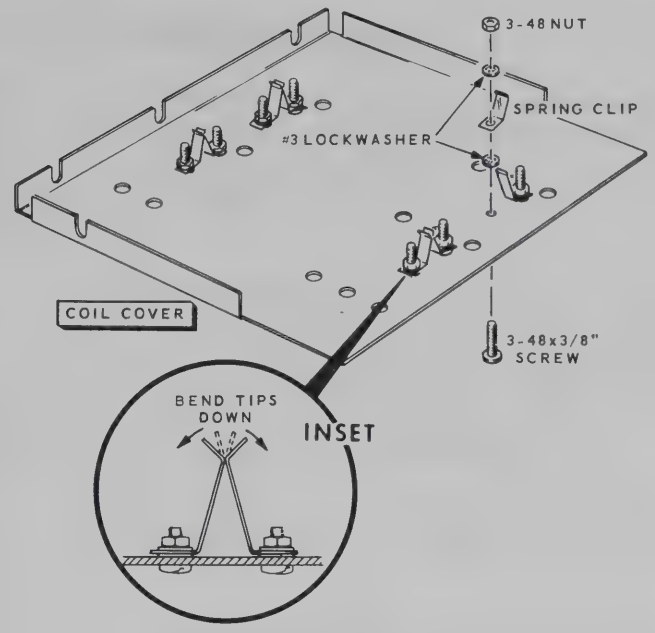
Install the tube shields as follows:

() Small tube shield (1-3/4" long) at V6.

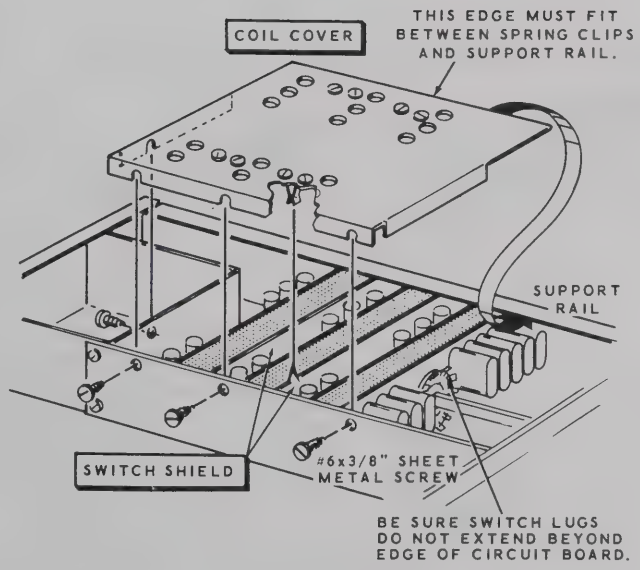
() Large tube shield (2" long) at V7.

() Large tube shield (1-3/4" long) at V1.

Refer to the Special Crystal Considerations section of the Manual on Page 96, for the crystal that may be used in the Auxiliary Crystal socket on the bandpass circuit board.



PICTORIAL 3-25



Detail 3-25A

POWER SUPPLY CONNECTIONS

The Transceiver was designed to operate with the Heathkit Models HP-13 (12 V DC power source) and HP-23 (117 V AC power source) Power Supplies. The following information will help you wire the 11-pin socket (supplied with the Transceiver) for the power cable of the Power Supply you intend to use.

HP-13 POWER SUPPLY CONNECTIONS

CAUTION: Be sure the alternate connection in the low voltage DC circuit of the HP-13 Power Supply is connected for +300 volts output as outlined in the HP-13 Manual. Be sure the automobile voltage regulator is set to less than 14.5 volts.

NOTE: If the Heathkit Model SBA-100-1 Mobile Mount is used, complete the power supply connections as directed in that manual.

Refer to Figure 1-4 for the following steps.

() Install the 11-pin socket cap over the free end of the 8-wire cable from the HP-13 Power Supply, as shown.

() Remove 3/4" of the outer insulation from the end of the 8-wire cable. Then remove 1/4" of insulation from the end of each wire.

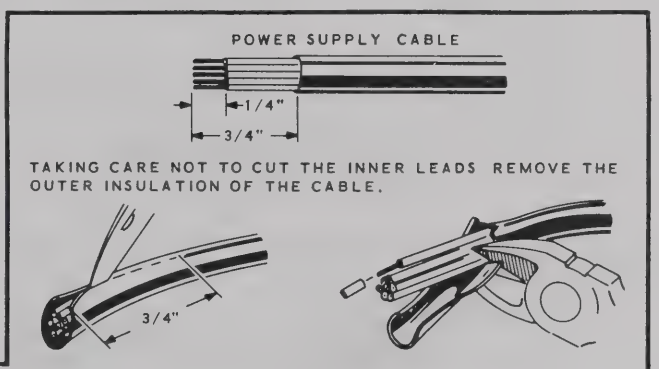
() Melt a small amount of solder on each of the exposed wire ends to hold the small strands of wire together.

() Insert the lead from the cap end of the fuseholder (an in-line fuseholder with lead is supplied with the HP-13 Power Supply) through the socket cap as shown.

If the Heathkit Model HA-14 Linear Amplifier is used, a coaxial cable from the HA-14 power connector should be inserted through the socket cap as shown. Use the coaxial cable with the inner lead connected to lug 12 and the shield to lug 1 of the HA-14 power connector.

() Cut seven 5/8" lengths of large sleeving and slip them over the indicated wires.

() Connect the wires of the 8-wire cable, the fuseholder lead, and the coaxial cable (if the HA-14 Linear Amplifier is used) to the 11-pin socket lugs as shown. Solder each connection.



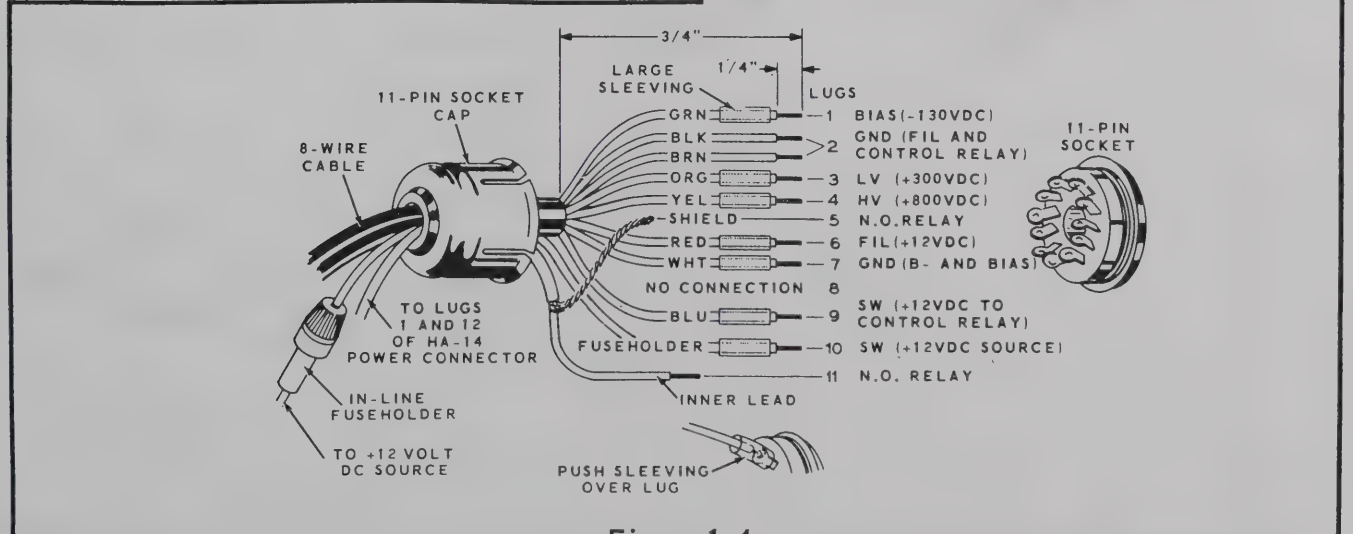


Figure 1-4

() Push the lengths of sleeving over the lugs of the socket.

() Snap the socket cap onto the 11-pin socket. IMPORTANT: When using the HP-13 Power Supply with the Transceiver, be sure the Bias control of the Power Supply is in its fully clockwise position. This setting will supply a maximum bias voltage at pin 9 of the power socket.

HP-23 POWER SUPPLY CONNECTIONS

CAUTION: Be sure the alternate connection in the low voltage DC circuit of the HP-23 Power Supply is connected for +300 volts DC output as outlined in the HP-23 Manual.

Refer to Figure 1-5 for the following steps.

() Install the 11-pin socket cap over the free end of the 8-wire cable from the Power Supply.

() Remove 3/4" of the outer insulation from the end of the 8-wire cable. Then remove 1/4" of insulation from the end of each wire.

() Melt a small amount of solder on each of the exposed wire ends to hold the small strands of wire together.

If the Heathkit Model HA-14 Linear Amplifier is to be used, a coaxial cable from the HA-14 power connector should be inserted through the socket cap as shown. Use the coaxial cable with the inner lead connected to lug 12 and the shield to lug 1 of the HA-14 power connector.

For the SB-200 and other Linear Amplifiers, use a piece of coaxial cable through the cap to bring out the relay connections.

() Cut seven 5/8" lengths of large sleeving and slip them over the indicated wires.

() Connect the wires of the 8-wire cable and the coaxial cable (if a Linear Amplifier is used) to the 11-pin socket lugs as shown. Solder each connection.

() Push the lengths of sleeving over the lugs of the socket.

() Snap the socket cap onto the 11-pin socket.

NOTE: With the above connections, the BIAS control in the HP-23 Power Supply is inoperative. Proper bias settings are accomplished with the BIAS control in the Transceiver.

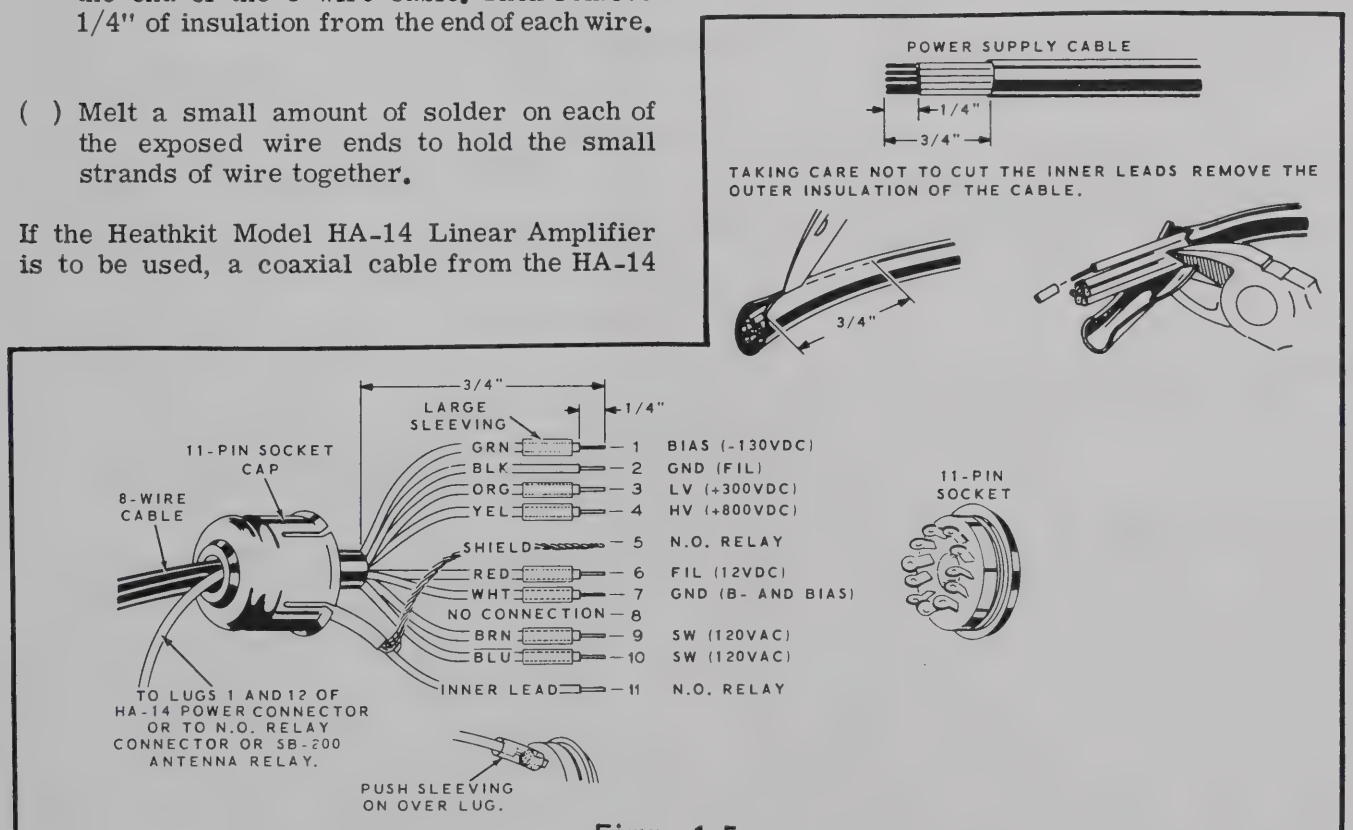


Figure 1-5

INITIAL TEST

CAUTION: BEFORE APPLYING POWER TO THE TRANSCEIVER, NOTE THAT LETHAL VOLTAGES ARE PRESENT BOTH ABOVE AND BELOW THE CHASSIS. DO NOT TOUCH ANY HIGH VOLTAGE POINTS WITH YOUR HANDS. USE WELL INSULATED TOOLS FOR ANY ADJUSTMENTS ON THE CHASSIS.

TO LESSEN THE SHOCK HAZARD, CONNECT A LEAD FROM A GOOD EARTH GROUND TO THE GROUND BOLT LOCATED ON THE REAR OF THE CHASSIS AND TO ALL TEST EQUIPMENT.

() Set the front panel controls as follows:

FINAL (round knob) to 80.

FINAL (lever knob) . . over the 50 Ω marking.

MODE. LSB.

RF GAIN. fully clockwise.

() Set the remaining front panel controls fully counterclockwise.

() Set the BIAS ADJUST control (on top of the chassis) fully clockwise.

() Connect the socket on the power supply cable to the Transceiver power plug.

() Connect the power supply to the proper power source.

() Connect an 8 Ω speaker to the 8 Ω socket, or a 600 Ω speaker to the 600 Ω socket at the rear of the Transceiver. CAUTION: Never operate the Transceiver unless a speaker or headphones are connected. For safety reasons, it is not recommended that headphones be used during the testing of the Transceiver.

If abnormal operation is encountered at any time during the following tests, turn the Transceiver off immediately, and refer to the In Case Of Difficulty section of the Manual on Page 110.

() Turn the FUNCTION switch to PTT. The panel lamps should now light with equal brilliance.

() Turn the METER switch to HV. The panel meter should indicate +800 to +900 volts.

() Visually check all parts for any signs of overheating, and check to see that each tube filament glows.

() Turn the METER switch to PLATE. The panel meter should indicate zero.

() Turn the AF GAIN control in a clockwise direction until noise is heard from the speaker. NOTE: If no noise is heard, check to be sure the transmitter is not keyed by a depressed switch on a PTT microphone, or a closed key.

() Check the voltages listed in the next two steps with a voltmeter. Refer to Figure 1-2 (fold-out from Page 97) for the location of test points.

() +300 volts DC from point 5 on the bandpass circuit board to chassis ground.

() -111 volts DC (bias) from point 4 on the audio circuit board to chassis ground.

ALIGNMENT

The coils and transformers in your Transceiver have been preset at the factory. Only slight readjustments should be necessary during the following alignment procedure.

The following equipment is necessary for alignment of the Transceiver.

1. An 11 megohm input VTVM (a 20 KΩ/V VOM may also be used).

2. A 50 Ω nonreactive dummy load that is capable of 100 watts dissipation, such as the Heathkit Model HN-31. Do not use light bulbs as a dummy load, as their resistance varies radically with voltage.

3. A receiver capable of receiving WWV at 2.5, 5, 10, or 15 mc. If this type of receiver is not available, a receiver tunable to a standard broadcast station that is operating at an even multiple of 100 kc (such as 600 kc, 1000 kc, etc.) can be used.

For the alignment of the transmitter section it is recommended that you use an oscilloscope, such as the Heathkit Model HO-10 Monitor Scope to observe the output RF envelope.

WARNING: Do not place the Transceiver in the transmit mode of operation until directed to do so or the Transceiver may be seriously damaged.

() Set the ANTENNA switch (located on rear of chassis) to the COM position.

() Connect a 50 Ω dummy load, capable of 100 watts dissipation, to the RF OUT jack on the rear of the chassis. CAUTION: Do not use light bulbs as a dummy load.

() Be sure an 8 Ω speaker is connected to the 8 Ω jack on the rear of the chassis.

() Preset the CAL XTAL trimmer so its notch is towards the 100 kc crystal as shown in Figure 1-1 (fold-out from Page 80).

() Preset the front panel controls as follows:

DRIVER PRESELECTOR - 12 o'clock position (3.7, 7.2, 14.2).

MIC/CW LEVEL - fully counterclockwise.

MODE - LSB

BAND - 3.5

Main tuning dial (LMO) - 3.7 mc (upper dial pointer at 2, and the circular dial at 0).

FUNCTION - PTT.

OSC MODE - LMO.

RF GAIN - fully clockwise.

METER - ALC.

AF GAIN - 9 o'clock position.

S-METER ADJUSTMENT

() After a few minutes warmup, adjust the METER ZERO control (on the IF circuit board directly behind the OSC MODE switch) for a zero reading on the panel meter.

RECEIVER ALIGNMENT

() Set the VTVM switches so the meter will indicate a negative (-) DC voltage.

() Connect the common lead of the VTVM to the chassis and the other lead to the circuit board foil at TP on the screened side of the bandpass circuit board near tube V19.

The heterodyne oscillator output will be checked at each position of the BAND switch in the following steps. If necessary, the heterodyne oscillator coils will be adjusted to obtain an output voltage reading.

() With the BAND switch at 3.5, the VTVM should indicate about -0.5 to -2 volts DC. If necessary, adjust coil 3.5 (near tube V11 on the top side of the RF-driver circuit board) for the proper VTVM reading. NOTE: When adjusting this coil in one direction, the oscillator output voltage will change rapidly; when adjusting the coil in the opposite direction from the peak, the output voltage will change slowly. Adjust the coil in the direction that gives the slower change in output voltage.

() Similarly, check the heterodyne oscillator output voltage at all positions of the BAND switch. If necessary, adjust the correct heterodyne oscillator coil for any BAND switch position that does not give an indication of about -0.5 to -2 volts DC on the VTVM. The heterodyne oscillator coils for bands 3.5, 14, and 28.5 are marked, and adjusted at the top side of the RF-driver circuit board; the coils for the other bands are marked on the shield cover, and are adjusted from the bottom of the chassis.

() Set the FUNCTION switch to CAL, then turn the Main Tuning dial back and forth around 3.7 mc to get the loudest signal. Check for the calibrate signal by turning the FUNCTION switch to VOX and back to CAL; the signal should stop and then start again and should peak with the DRIVER PRESELECTOR.

() Disconnect the VTVM leads from the Transceiver.

The S-Meter will be used as an output indicator during the remaining alignment of the Transceiver, and the 100 kc calibrator will be used as a signal source.

() Adjust transformer T201 for maximum volume.

() Adjust the top and bottom slugs of transformer T102 for a maximum volume or S-Meter indication.

() Adjust the slug of transformer T103 for a maximum S-Meter indication.

() Repeat the adjustments of transformers T201, T102, and T103 for a maximum S-Meter indication.

The driver grid and driver plate coils will be adjusted in the following steps. The coil locations are marked on the shield cover at the bottom of the chassis. These coils must be adjusted in the proper sequence as follows:

() Adjust driver grid coil 3.5 and driver plate coil 3.5 for a maximum S-Meter indication. The S-Meter will move slowly during the adjustment of these two coils.

() Change the setting of the front panel controls as follows:

DRIVER PRESELECTOR - 29.2 position. See the inset drawing on Figure 1-2 (fold-out from Page 97).

BAND - 29.0

Main Tuning dial (LMO) - 29.2 mc

() Turn the Main tuning dial back and forth around 29.2 mc to get the loudest signal. Check for the calibrate signal by turning the DRIVER PRESELECTOR to see if there is any variation in volume. Return the DRIVER PRESELECTOR to the 29.2 position.

() Adjust driver grid coil 29 and driver plate coil 29 for a maximum S-Meter indication.

() Change the setting of the front panel controls as follows:

DRIVER PRESELECTOR - 21.2 position. See the inset drawing on Figure 1-2.

BAND - 21.0

Main tuning dial - 21.2 mc.

() Turn the Main tuning dial back and forth around 21.2 mc for the loudest signal. Check for the calibrate signal by turning the FUNCTION switch to VOX and back to CAL again.

() Adjust driver grid coil 21 and driver plate coil 21 for a maximum S-Meter indication.

() Turn the BAND switch to 14.0, the Main tuning dial to 14.2 mc, and the DRIVER PRESELECTOR to the 14.2 position.

() Tune the Main tuning dial for the loudest signal and check for the calibrate signal.

() Adjust driver grid coil 14 and driver plate coil 14 for a maximum S-Meter indication.

() Set the BAND switch at 7.0 and the Main tuning dial at 7.2 mc.

() Tune the Main tuning dial for the loudest signal.

() Adjust driver grid coil 7 and driver plate coil 7 for a maximum S-Meter indication.

() Turn the FUNCTION switch to PTT

Proper receiver operation will be indicated by calibrator signals of S9 +30 db at 3700 kc and decreasing to S6 at 29.2 mc.

TRANSMITTER ALIGNMENT

See the "Reading The Meter" section on Page 106 before making any more adjustments.

NOTE: The coil cover must be in place for transmitter operation.

() Connect a push-to-talk microphone to the MIC connector on the front panel.

() If an oscilloscope is available, connect the oscilloscope between the RF OUT jack and the dummy load. Be sure the dummy load is capable of 100 watts dissipation.

() Set the NEUTRALIZING CAPACITOR (on the RF cage) at the 1/2 meshed position. The slot in the shaft should be vertical.

() Set the front panel controls as follows:

DRIVER PRESELECTOR - 12 o'clock position.

MIC/CW LEVEL - fully counterclockwise.

FINAL (round knob) - to 80.

FINAL (lever knob) - over the 50 Ω marking.

MODE - LSB.

BAND - 3.5

Main tuning dial - 3.7 mc.

FUNCTION - PTT.

OSC MODE - LMO.

METER - PLATE.

() Press the PTT microphone button and turn the BIAS ADJUST control in the Transceiver for a plate current reading of 50 ma. If the meter reads more than 100 ma, do not press the microphone button more than a few seconds at one time, until the plate current has been properly adjusted.

() If an oscilloscope is not used, preset the RELATIVE POWER control to the center of its range and turn the METER switch to REL PWR.

() With the MODE switch set at the TUNE position, slowly turn the MIC/CW LEVEL control in a clockwise direction until there is an indication of RF output on the meter or oscilloscope.

() Turn the MIC/CW LEVEL control for a low level of RF output, then adjust the DRIVER PRESELECTOR control for maximum RF output.

() Adjust the FINAL tune (round knob) control for maximum RF output.

() Turn the MIC/CW LEVEL control counterclockwise to obtain approximately 1/4 maximum output.

() Adjust transformer T1 for maximum RF output. It should not be necessary to adjust this transformer more than one complete turn.

() Turn the MIC/CW LEVEL control to obtain maximum RF output on the meter or oscilloscope. Then turn the METER switch to GRID (grid current); the meter should indicate full scale.

() Turn the METER switch to the PLATE position.

() Adjust the FINAL tune control for minimum plate current. Turn the METER switch to REL PWR or observe the output on an oscilloscope. Adjust the FINAL tune control for maximum meter indication and note the position of the FINAL tune control. (If necessary, readjust the RELATIVE POWER control so the meter does not indicate beyond full scale.) If maximum relative power and minimum plate current do not occur at the same point of tuning, then turn the neutralizing capacitor a small amount. Check the position of the FINAL tune control at minimum plate current and also at the maximum relative power indication. The neutralizing capacitor should be adjusted a small amount at a time until minimum plate current and maximum relative power occur at the same point of tuning the FINAL tune control.

() Turn the MIC/CW LEVEL control fully clockwise.

() Turn the MODE switch to LSB, push the PTT switch on the microphone, then adjust the CARRIER NULL control for minimum RF output. NOTE: Readjust the RELATIVE POWER control for more sensitivity if the panel meter is used to indicate relative power.

() Adjust the CARRIER NULL capacitor for minimum RF output.

() If necessary, repeat the adjustments of the CARRIER NULL control, and the CARRIER NULL capacitor until the RF output or null reading is about the same on both the LSB and USB positions of the MODE switch. (The output should null down to a quarter of a volt or less, if an RF voltmeter is available.)

CAUTION: The 6.8 mc trap coil is sealed, and should not be turned.

() Turn the OSC MODE switch to LMO. Tune for maximum output, and adjust the RELATIVE POWER control for a 6 to 8 meter reading.

() Leave the BAND switch at 3.5, and adjust for a maximum output. Then set the MIC/CW LEVEL control for a grid current reading of about 0.3 ma.

() Adjust heterodyne oscillator coil 3.5 for maximum grid current, with the tuning on the "slow" side of the peak.

() At each position of the BAND switch, adjust the heterodyne oscillator coil for maximum grid current. Adjust the coil that has the same number as the BAND switch position.

() Check the grid current at each position of the BAND switch. The maximum grid current reading should be near or over full scale on each band.

() Set the BAND switch at 21.0 and turn the Main tuning dial to read 21.2 mc.

() Position the free end of the driver neutralizing wire into hole W in the RF-driver circuit board as shown in Figure 1-1 (fold-out from Page 80).

() Adjust the DRIVER PRESELECTOR control for maximum RF output; then turn the control back and forth to see if this produces a smooth peaking in RF output.

() If the turning of the DRIVER PRESELECTOR control causes ragged changes in the RF output, readjust the position of, or bend, the driver neutralizing wire to produce a smooth peaking in RF output.

() Check the final neutralizing again at 14.2 mc as in the first step on this page.

CRYSTAL CALIBRATOR ALIGNMENT

In the following steps, the 100 kc crystal calibrator signal is adjusted by "zero beating" it against the accurate signal from WWV on another receiver, or against the signal from a standard broadcast station that is on a multiple of 100 kc.

Zero beat will occur when a harmonic of the 100 kc crystal calibrator signal corresponds to the frequency of the station tuned in on the external receiver. As zero beat is approached, a tone will be heard that decreases in frequency until it stops completely at the zero beat point; then the tone begins to increase again.

If the external receiver has an S-Meter, accurate alignment can be achieved by observing the S-Meter as zero beat is approached. When you tune close to zero beat, the S-Meter will start to pulsate. The closer you approach zero beat, the slower the pulsations will become. At zero beat the pulsations will stop.

IMPORTANT: For greatest accuracy, be sure to adjust the crystal calibrator as close to zero beat as possible. A 20 cps error at the 100 kc calibrator frequency, for example, would cause a 740 cps error at 3.7 mc (where the 37th harmonic of 100 kc would be used for dial calibration purposes; 100 kc x 37 = 3.7 mc; 20 cps x 37 = 740 cps).

() Connect the free end of the antenna wire from the external receiver to the REC ANT jack at the rear of the Transceiver.

() Set the Transceiver controls as follows:

FUNCTION switch - CAL.

AF GAIN control - full counterclockwise.

ANTENNA switch (at rear of Transceiver) - REC.

MODE switch - SW, LSB, or USB.

() Tune the external receiver to WWV; or a standard broadcast station broadcasting at a frequency which is a multiple of 100 kc.

() Carefully adjust the CAL XTAL trimmer capacitor (on the bandpass circuit board) for a "zero beat" in the external receiver. When WWV is tuned in, the period when no tone modulation is present allows the zero beat to be more easily heard.

() Switch the Transceiver FUNCTION switch between VOX and CAL to be sure the external receiver S-Meter stays steady, thus insuring a true zero beat.

() Remove the external receiver antenna wire from the REC ANT jack on the Transceiver.

NOTE: To make sure it is heard on each band, a high content of harmonic energy is needed in the 100 kc calibrate signal. Because of this, some spurious signals may also appear when tuning across some segments of the bands. The desired 100 kc calibrate signals are easily identified by their greater signal strength. Also, the proper harmonics may be peaked by the DRIVER PRESELECTOR.

LMO SHIFTER ADJUSTMENT

() Adjust the Main tuning dial to 3.7 mc (BAND switch to 3.5, the upper dial at 2, and the circular dial to 0).

() Set the FUNCTION switch to CAL.

() Turn the MODE switch to USB.

() Carefully zero beat the calibrator signal (using the Main Tuning dial) and peak the DRIVER PRESELECTOR control.

() Set the MODE switch to LSB. Be careful not to touch the Main Tuning dial. Note that the calibrator signal may or may not be exactly at zero beat in the LSB position.

() Turn the frequency shifter adjustment on the LMO for an exact zero beat in the LSB mode. See Figure 1-1 (fold-out from Page 80).

() Recheck the zero beat in the USB mode to be certain of the adjustment. Repeat the procedure if necessary.

DIAL CALIBRATION

() Zero beat the Main Tuning dial at 3.7 mc.

() Check for the calibrate signal and set the Zero Set dial. If the hairline is not close to the window center, proceed with the following steps.

() Remove the knob from the Main Tuning shaft without disturbing the zero beat setting.

() Place a screwdriver through the hole in the dial escutcheon (directly above the main tuning shaft) and into the LMO dial drive shaft.

() Hold the LMO dial drive shaft on zero beat and loosen the setscrew in the circular dial. Turn the circular dial until the 0 is directly behind the line on the zero set dial. Now retighten the setscrew in the circular dial. Be careful not to short circuit the pilot lamp socket with the allen wrench.

() Make sure the circular dial turns freely and the nylon spiral follower is properly engaged in the spiral groove before proceeding.

() Replace the knob on the Main Tuning shaft.

This completes the alignment of your Transceiver.

SPECIAL CRYSTAL CONSIDERATIONS

CRYSTAL CONTROL FOR MARS OR NET OPERATION

With the Mode switch of the Transceiver in the AUX T position, the transmitter operates at a fixed frequency that is determined by crystal Y5 in the crystal oscillator circuit of tube V5B. The receiver is still tuned by the LMO.

By placing the Mode switch in the XTAL position, both the transmitter and receiver frequencies are determined by crystal Y5.

IMPORTANT: Because of the steep-sided characteristics of Bandpass filter T202, operation of the Transceiver using a crystal at Y5 will be limited to approximately 25 kilocycles out of each band. Also, since the DRIVER PRESELECTOR tunes the same circuit for both transmit and receive, the frequency spread between the transmit and receive frequencies is limited to about 20 kc at 3.5 mc, 40 kc at 7 mc, etc.

Select the crystal frequency for Y5 for the sideband to be used, or for CW operation. The examples below are for one of the MARS channels located at 7.305 mc.

For USB and compatible USB-CW operation:

$f_{x\,(USB)} = f_h - f_m - 3.3964$

For LSB operation:

$f_{x\,(LSB)} = f_h - f_m - 3.3936$

For CW Net operation:

$f_{x\,(CW)} = f_h - f_n - 3.3954$

Definition of terms:

f_x = Crystal frequency in mc, for crystal Y5.

f_h = heterodyne crystal frequency, different for each band:

BAND	f_h
3.5	12.3950
7.0	15.8950
14.0	22.8950
21.0	29.8950
28.0	36.8950
28.5	37.3950
29.0	37.8950
29.5	38.3950

f_m = carrier frequency of desired SSB operation, further specified by LSB or USB designations. This is the operating frequency for SSB.

f_n = Exact transmitter frequency for CW Nets. Use this where CW only is used on a specific frequency. This operation is not compatible with USB operation, as the receiving station would have to retune his receiver 1 kc lower to receive SSB, and this would be impossible if he were crystal controlled.

Compatible USB-CW operation is used in some MARS Nets. In this service, a channel is specified which is wide enough for only one sideband. The carrier frequency is specified at the lower edge of the channel, and CW transmission is 1 kc higher than the carrier frequency. This 1 kc offset then produces a 1 kc beat note in the receivers set to USB or CW without any tuning. Either USB or CW can then be transmitted or received.

When using auxiliary crystal control, switching modes will cause the transmitting frequency to change, except for compatible USB-CW operation. Therefore, care must be taken to avoid out-of-band operation by inadvertently switching to the wrong mode.

Example: Mars SSB on USB at 7.305 mc.

$f_{h(7.0)}$ = 15.8950

$f_{m(USB)}$ = − 7.3050

8.5900

8.5900

− 3.3964

$f_{x(USB)}$ = 5.1936 mc

Caution: Always be sure to use the correct heterodyne crystal frequency.

When purchasing crystals for Y5, specify the frequency and the following characteristics:

Operation Mode.	Fundamental.
Tolerance.	.01 %.
Holder	HC-6/U.
Pin Diameter	.050".
Pin Spacing	.486.
Load Capacity (C_L). .	32 $\mu\mu$f.
Internal Capacity (C_O).	7 $\mu\mu$f maximum.
Series Resistance (R_S).	25 Ω maximum.
Drive Level	10 milliwatts.

The trimmer capacitor next to Y5 (AUX TRIM) can be adjusted for an exact MARS or Net frequency.

HETERODYNE OSCILLATOR

The heterodyne oscillator crystals that are supplied with the Transceiver provide coverage from 3.5 to 4.0 mc, 7.0 to 7.3 mc, 14.0 to 14.5 mc, 21.0 to 21.5 mc, and 28.0 to 30.0 mc. Since the driver grid and driver plate coils must be sequence-tuned, because of their series-parallel arrangement, other heterodyne crystals for out-of-band operation could introduce a wide variety of possible tuning conditions. Therefore, the use of crystals of frequencies other than those supplied are not recommended.

CABINET INSTALLATION

NOTE: If the Transceiver is to be mounted with the Heathkit Mobile Mount, Model SBA-100-1, be sure to install the plastic snap-in nuts in the side-front corners of the chassis and install the threaded bushing in the rear apron of the chassis. These parts are supplied with the Mobile Mount.

Refer to Figure 1-6 for the following steps.

() Position the cabinet right-side up on the work area.

() Slide the chassis into the cabinet from the front.

() Carefully turn the cabinet and chassis over.

() Install a rubber foot at each rear corner with 6-32 x 5/8" screws and #6 flat washers. The screws fit through the cabinet holes into the tapped holes in the chassis.

() Install a rubber foot and a foot spacer at each front corner of the cabinet with a 6-32 x 1-1/2" screw and a #6 flat washer.

() Remove the protective backing from the high voltage label. Then press the label firmly in place inside the cabinet covers, as shown. It may be necessary to trim the label to size.

() Start 8-32 x 1/4" oval head screws into the front-side holes of the cabinet.

() Close the cover and tighten the screws.

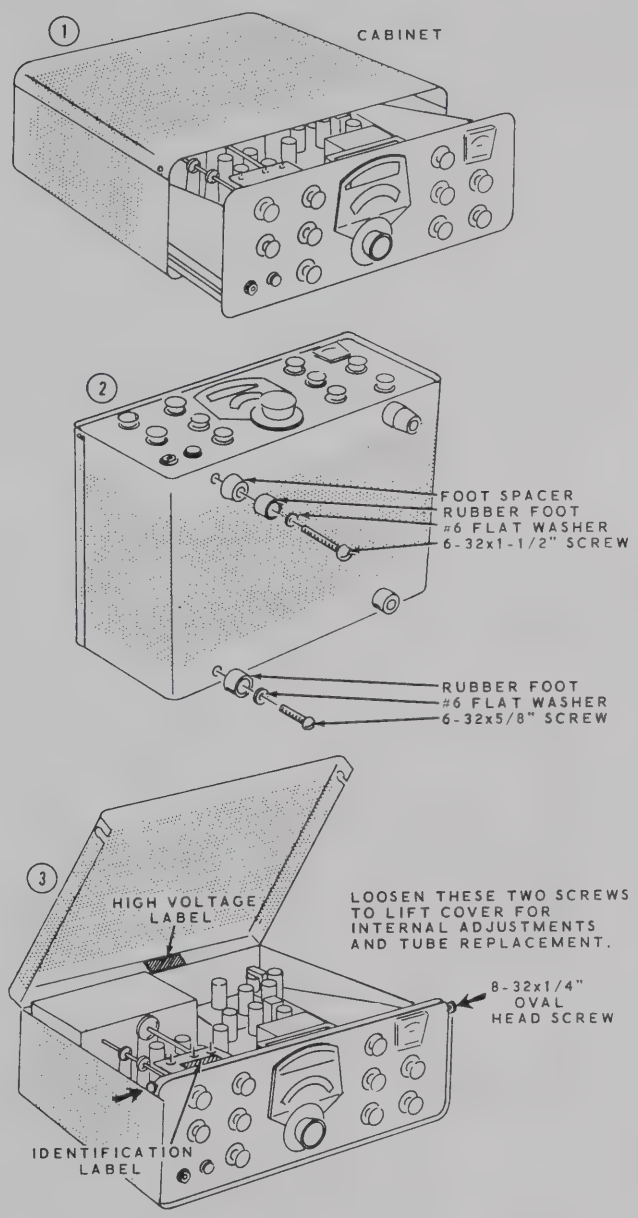


Figure 1-6

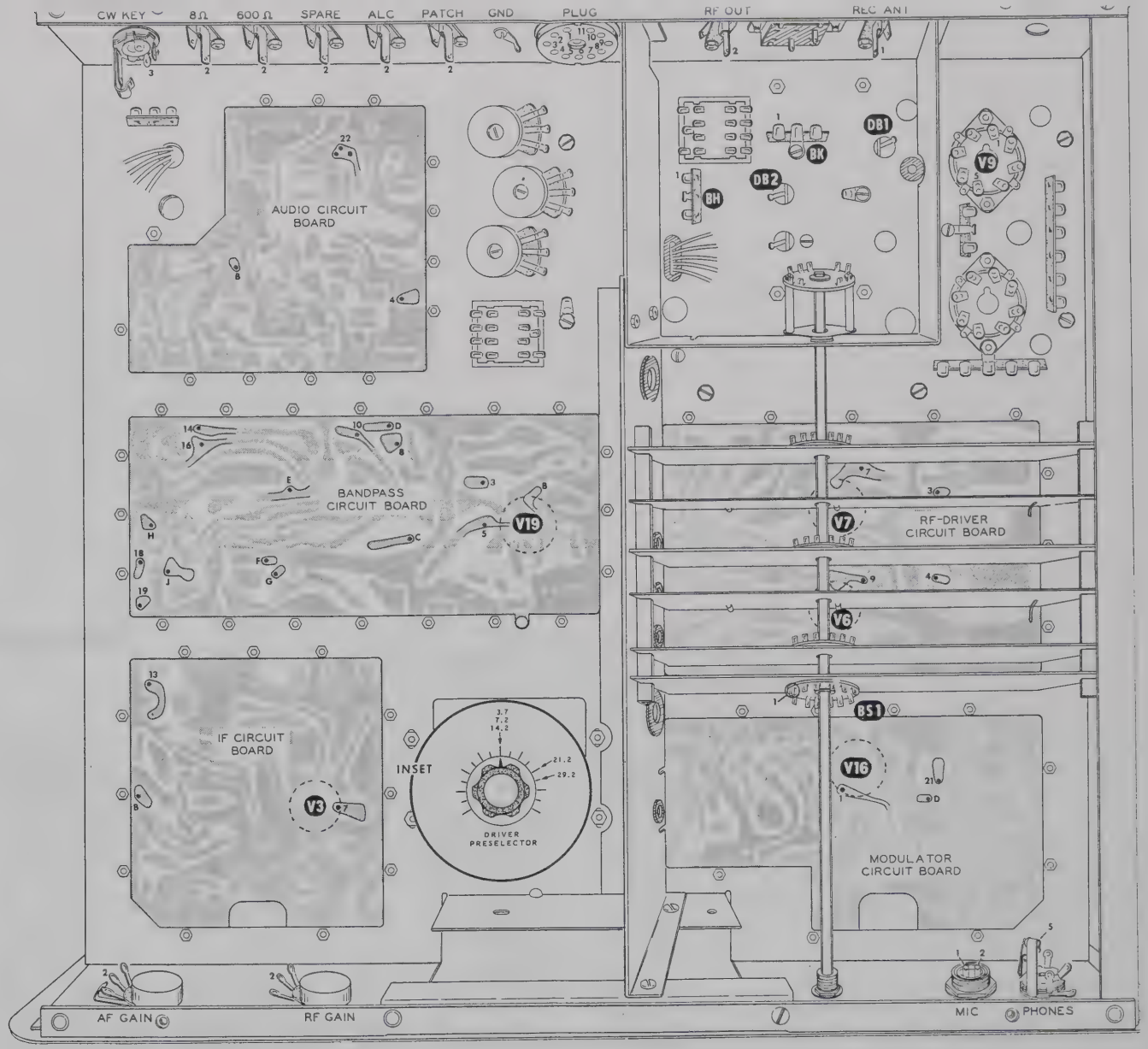

CW KEY
8Ω
600Ω
SPARE
ALC
PATCH
GND
PLUG
RF OUT
REC ANT
AUDIO CIRCUIT BOARD
BANDPASS CIRCUIT BOARD
V19
IF CIRCUIT BOARD
V3
INSET
3.7
7.2
14.2
21.2
29.2
DRIVER PRESELECTOR
DB1
BK
DB2
BH
V9
V7
RF-DRIVER CIRCUIT BOARD
V6
BS1
V16
MODULATOR CIRCUIT BOARD
AF GAIN
RF GAIN
MIC
PHONES

FIGURE 1-2

MICROPHONE CONNECTION

Refer to Figure 1-7 for the following steps.

NOTE: A high-impedance microphone equipped with a push-to-talk switch should be used with the Transceiver so either the PTT or VOX methods may be used to turn on the Transmitter. A two-pin microphone connector (amphenol 80 MC2M) is furnished for this purpose. It should be connected to the microphone cable as directed in the following steps.

() Determine the desired length of your microphone cable, and cut off any excess. Unbraid the shield for a distance of 7/8".

() Remove 1/2" of insulation from the ends of the two inner leads. Then melt a small amount of solder on the exposed lead ends. Now proceed to the steps on Figure 1-7.

IDENTIFICATION LABEL

NOTE: The blue and white identification label shows the Model Number and Production Series Number of your kit. Refer to these numbers in any communications with the Heath Company; this assures you that you will receive the most complete and up-to-date information in return.

() Install the identification label in the following manner:

1. Select a location for the label where it can easily be seen when needed, but will not show when the unit is in operation. This location might be on the control bracket. See Figure 1-6.

2. Carefully peel away the backing paper. Then press the label into position.

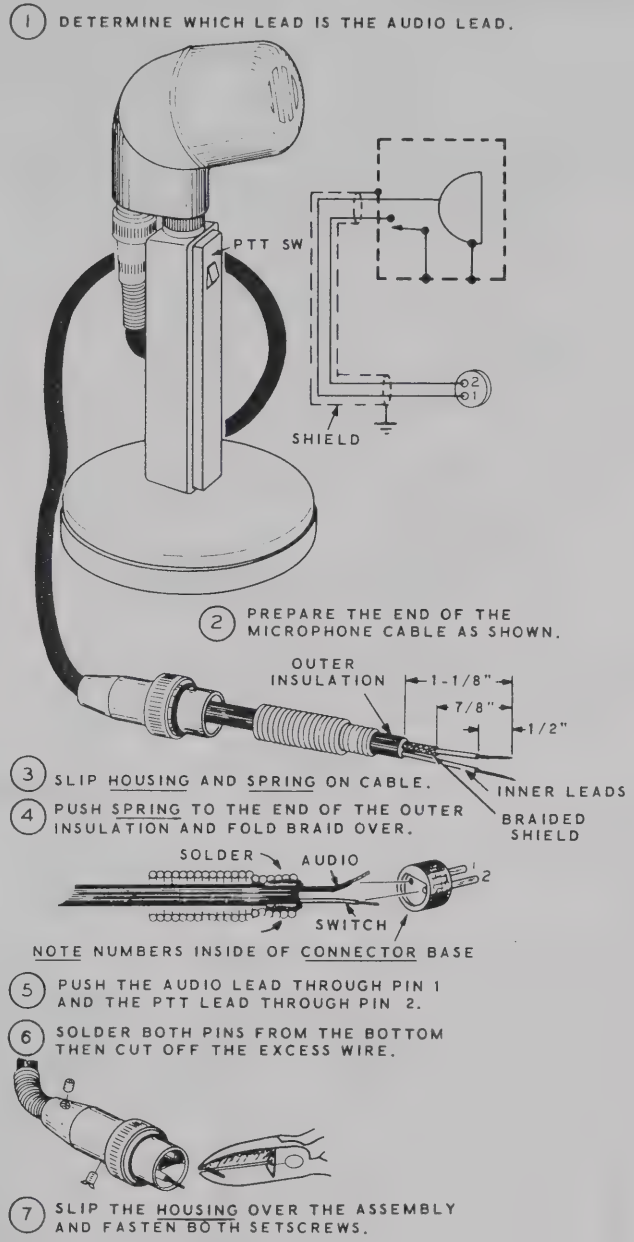


Figure 1-7

INSTALLATION

Because of the heat generated by the tubes of the Transceiver, it should be placed where adequate air circulation is present. Do not place other equipment, papers, or other objects under or on top of the Transceiver that would cut off air circulation through the unit.

FIXED STATION INSTALLATION

Figure 1-8 shows a Typical fixed station hook-up. Various accessories are shown that may be used with the Transceiver. These same accessories may also be used with a linear amplifier; however, the linear amplifier is shown separately in Figure 1-10 for clarity.

When using the Transceiver as a complete station unit, the ANTENNA switch should be in the COMmon position as shown in Figure 1-8. Cables can be prepared following the instructions in Figure 1-9. Make the cables to the lengths required for your installation.

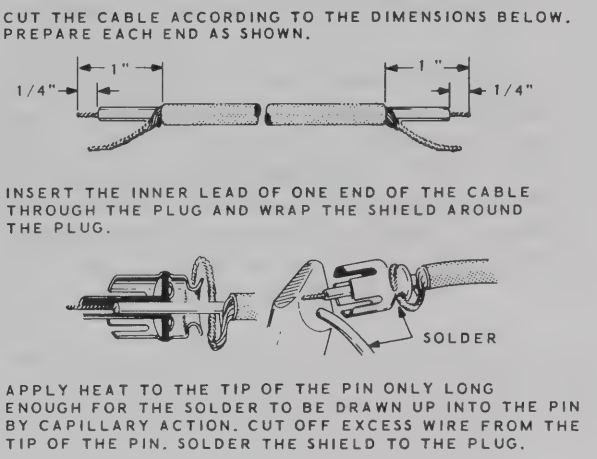


Figure 1-9

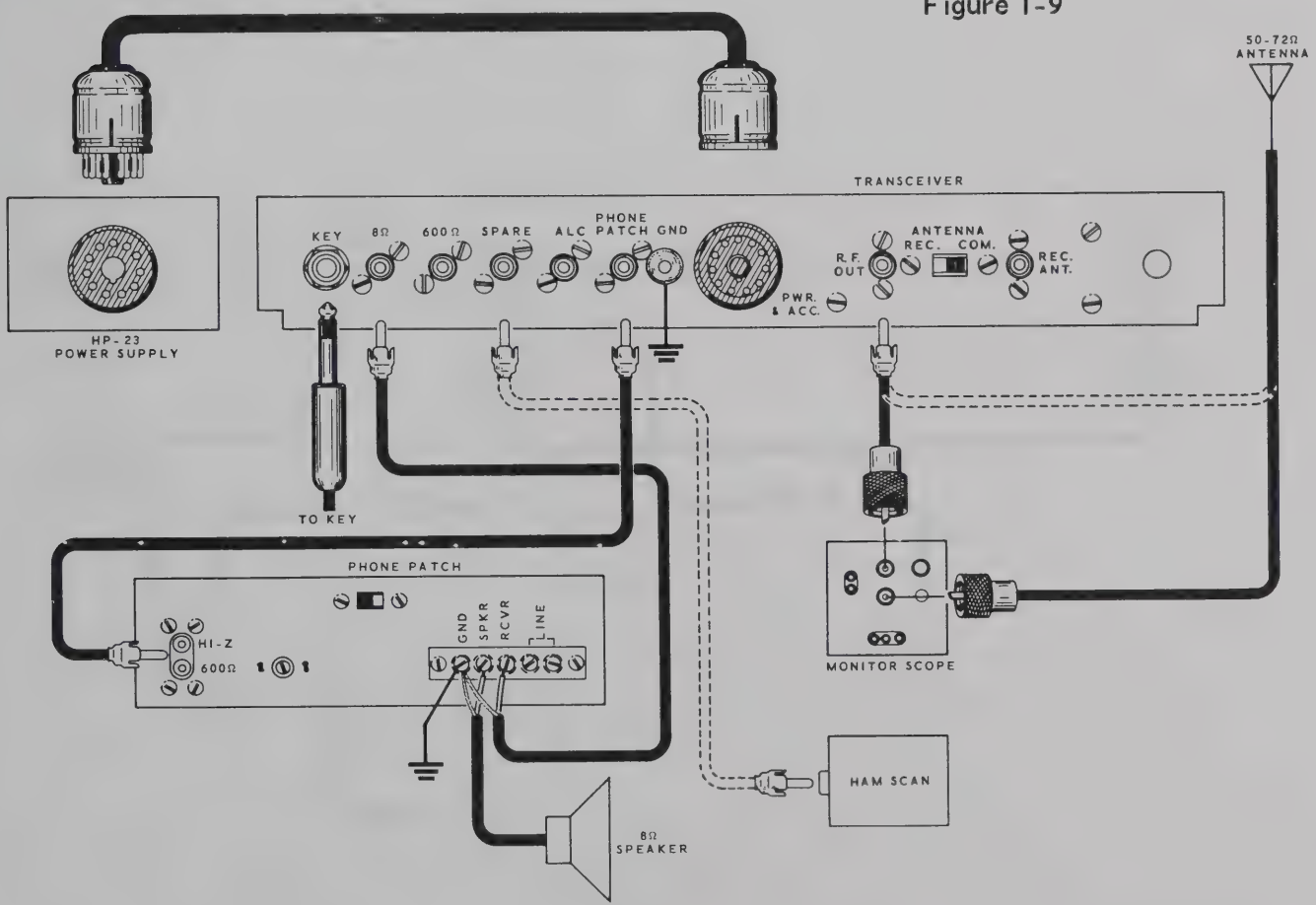


Figure 1-8

Linear Amplifier Considerations

SB-200 AND HA-14

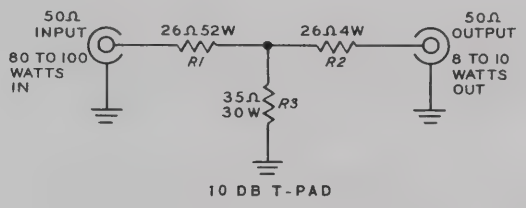
Information regarding antenna switching, cutoff bias, and ALC should be obtained from the Linear Amplifier Instruction manual. Figure 1-10 shows a typical installation using an SB-200 amplifier. This linear amplifier provdies ALC voltage and has internal antenna switching.

OTHER LINEAR AMPLIFIERS

A spare set of SPDT relay contacts are available at the PWR and ACC (power and accessory) plug of the Transceiver (pins 5, 8, and 11). These contacts can be used to switch an external antenna relay. Power for the external antenna relay will have to be obtained externally. Under these conditions the ANTENNA switch should be in the RECeive position with the coaxial cables connecting the RF OUT to the linear amplifier; the linear output, the antenna, and the REC ANT to the relay.

If the linear amplifier being used has internal antenna switching capabilities, the ANTENNA switch on the Transceiver can be at the COMmon position. Under these conditions, an external antenna relay is not necessary, and there will be no connection to the RECeiver ANTenna jack on the Transceiver. The spare relay contacts in the Transceiver can now be used to switch either the cutoff bias or the internal antenna relay of the linear amplifier.

If the output power of the Transceiver is too high for the drive requirements of the linear amplifier, a swamping T-pad must be used between the two units. Such a pad is shown below. This pad will provide 10 db attenuation with a terminal impedance of 50 ohms. This will allow adequate driving power for a linear amplifier that requires 10 watts input.



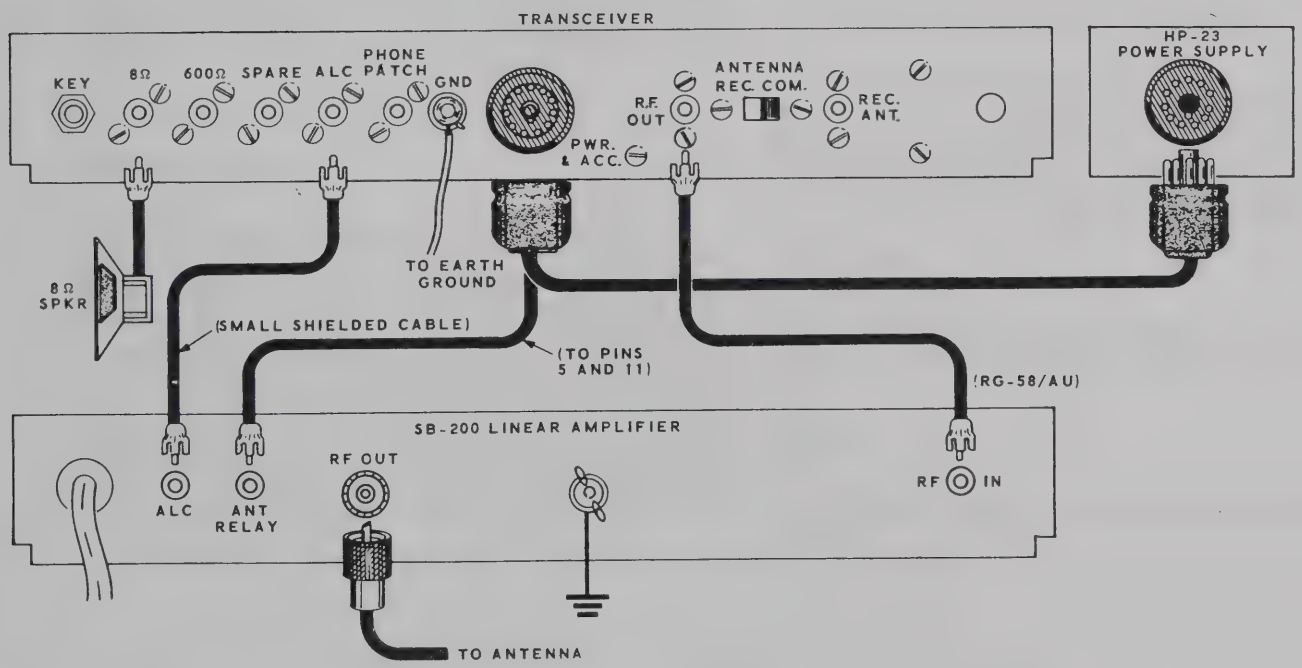


Figure 1-10

T-Pad

Resistors R1, R2, and R3 can be made from combinations of common 2 watt carbon resistors wired into a metal box with phono-type jacks or connectors. NOTE: Do not use wire-wound resistors; the resistors in the T-pad must be a non-inductive type.

Combinations of 2 watt carbon resistors for a pad suitable for SSB service at reduced power levels, are listed below. WARNING: Steady full level carrier excitation should be avoided except for very brief test periods, since the dissipation rating of the resistors will be exceeded.

R1 = thirteen 330 Ω 2 watt carbon resistors in parallel.

R2 = two 47 Ω 2 watt carbon resistors in parallel.

R3 = eight 270 Ω 2 watt carbon resistors in parallel.

MOBILE INSTALLATION

A Mobile Mount (Heathkit Model SBA-100-1) is available for use with the Transceiver, and is recommended for Mobile operation. With this mount, the Transceiver can be quickly and easily installed or removed so it can be used for mobile and fixed station operation.

Mobile Antennas

Mobile antennas present loading situations which must be carefully handled for each band. Because whip antennas must be kept short for mobile use, they represent only a fraction of a wavelength on the lower frequency bands. Thus, their radiation resistance is extremely low and their reactance is capacitive. Therefore, loading coils must be used and the losses kept low to insure a minimum loss of radiated power in the form of heat in the loss resistances.

A good quality antenna will have low resistanc losses, and with a high "Q" loading coil, it bandwidth on 75 meters could be less than th IF bandwidth of many receivers used for AM reception. A typical loading coil with a "Q" o 300 would have a bandwidth of 13 kc to the half power points at 3.9 mc.

Because of this sharp tuning, deviation from th center frequency of the antenna will quickl introduce enough reactance to present an im possible loading situation to the transmitter The antenna should be carefully adjusted for low SWR before placing the transmitter i operation.

The following is a list of antenna considerations for each band of the Transceiver.

3.5-4 MC

This band presents the greatest problem. Th normal tuning range of a good antenna on thi band is about 10 kc on each side of the antenna resonant frequency.

Actual measured resistance at the base of a antenna at these frequencies is 15 to 20 ohms this represents an SWR of nearly 3 to 1. In orde to get proper matching to the 50 ohm line, 1000 $\mu\mu$f mica capacitor should be connecte between the inner conductor and shield of th coaxial line at the base of the antenna.

The antenna tuning must be checked after th capacitor is installed. This capacitor is par of an L network that is used to get a 50 ohm match. The inductive portion of this network i formed by a portion of the loading coil.

7-7.3 MC

This band ordinarily does not need a correctin network, and has a useful bandwidth of about 5 kc.

14 MC

No network needed. Bandwidth approximatel 100 kc.

T-Pad

Resistors R1, R2, and R3 can be made from combinations of common 2 watt carbon resistors wired into a metal box with phono-type jacks or connectors. NOTE: Do not use wire-wound resistors; the resistors in the T-pad must be a non-inductive type.

Combinations of 2 watt carbon resistors for a pad suitable for SSB service at reduced power levels, are listed below. WARNING: Steady full level carrier excitation should be avoided except for very brief test periods, since the dissipation rating of the resistors will be exceeded.

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Mobile antennas present loading situations which must be carefully handled for each band. Because whip antennas must be kept short for mobile use, they represent only a fraction of a wavelength on the lower frequency bands. Thus, their radiation resistance is extremely low and their reactance is capacitive. Therefore, loading coils must be used and the losses kept low to insure a minimum loss of radiated power in the form of heat in the loss resistances.

A good quality antenna will have low resistance losses, and with a high "Q" loading coil, its bandwidth on 75 meters could be less than the IF bandwidth of many receivers used for AM reception. A typical loading coil with a "Q" of 300 would have a bandwidth of 13 kc to the half-power points at 3.9 mc.

Because of this sharp tuning, deviation from the center frequency of the antenna will quickly introduce enough reactance to present an impossible loading situation to the transmitter. The antenna should be carefully adjusted for a low SWR before placing the transmitter in operation.

The following is a list of antenna considerations for each band of the Transceiver.

3.5-4 MC

This band presents the greatest problem. The normal tuning range of a good antenna on this band is about 10 kc on each side of the antennas resonant frequency.

Actual measured resistance at the base of an antenna at these frequencies is 15 to 20 ohms; this represents an SWR of nearly 3 to 1. In order to get proper matching to the 50 ohm line, a 1000 $\mu\mu$f mica capacitor should be connected between the inner conductor and shield of the coaxial line at the base of the antenna.

The antenna tuning must be checked after the capacitor is installed. This capacitor is part of an L network that is used to get a 50 ohm match. The inductive portion of this network is formed by a portion of the loading coil.

7-7.3 MC

This band ordinarily does not need a correcting network, and has a useful bandwidth of about 50 kc.

14 MC

No network needed. Bandwidth approximately 100 kc.

21 MC

No network needed. Bandwidth is about 150 kc.

28 MC

The antenna for this band is normally cut for 1/4 wavelength, with no loading coil required. The bandwidth is about 200 kc.

Noise Suppression

The reason for having good electrical interference suppression at the source, is that strong electrical pulses contain enough energy, when integrated, to raise the AVC voltage of the receiver, causing the gain to drop whenever the engine is speeded up. In addition, the IF amplifiers of the receiver will tend to lengthen the duration of the noise pulses because the relatively high-Q crystal filter will ring, or oscillate, when excited by a sharp pulse such as produced by ignition noise.

Determining the source of various types of noise can be difficult, particularly when several items are contributing to the noise. Follow the procedure outlined below to isolate and identify the various items that may be producing the major noise interference.

In most cases, one source of interference will mask others. Consequently, it will be necessary to suppress the strongest item first, and then continue with the other steps. Figure 1-11 shows a typical ignition system and the suggested placement of noise suppression components.

1. Position the vehicle in an area that is free from other man-made electrical interference such as power lines, manufacturing processes, and particularly other automobiles.

2. With the Transceiver on, run the automobile at medium speed. Then let up on the gas, and turn the ignition switch off and to the accessory position. Allow the vehicle to coast in gear. If all noise stops, the major source of interference is from the ignition system.

3. If the noise interference continues from step 2, but at a reduced level, both the ignition and generator systems are at fault.

4. If the noise has a "whine" characteristic and changes in pitch with varying engine speed and is still present with the ignition off, then the generator is the major source of interference.

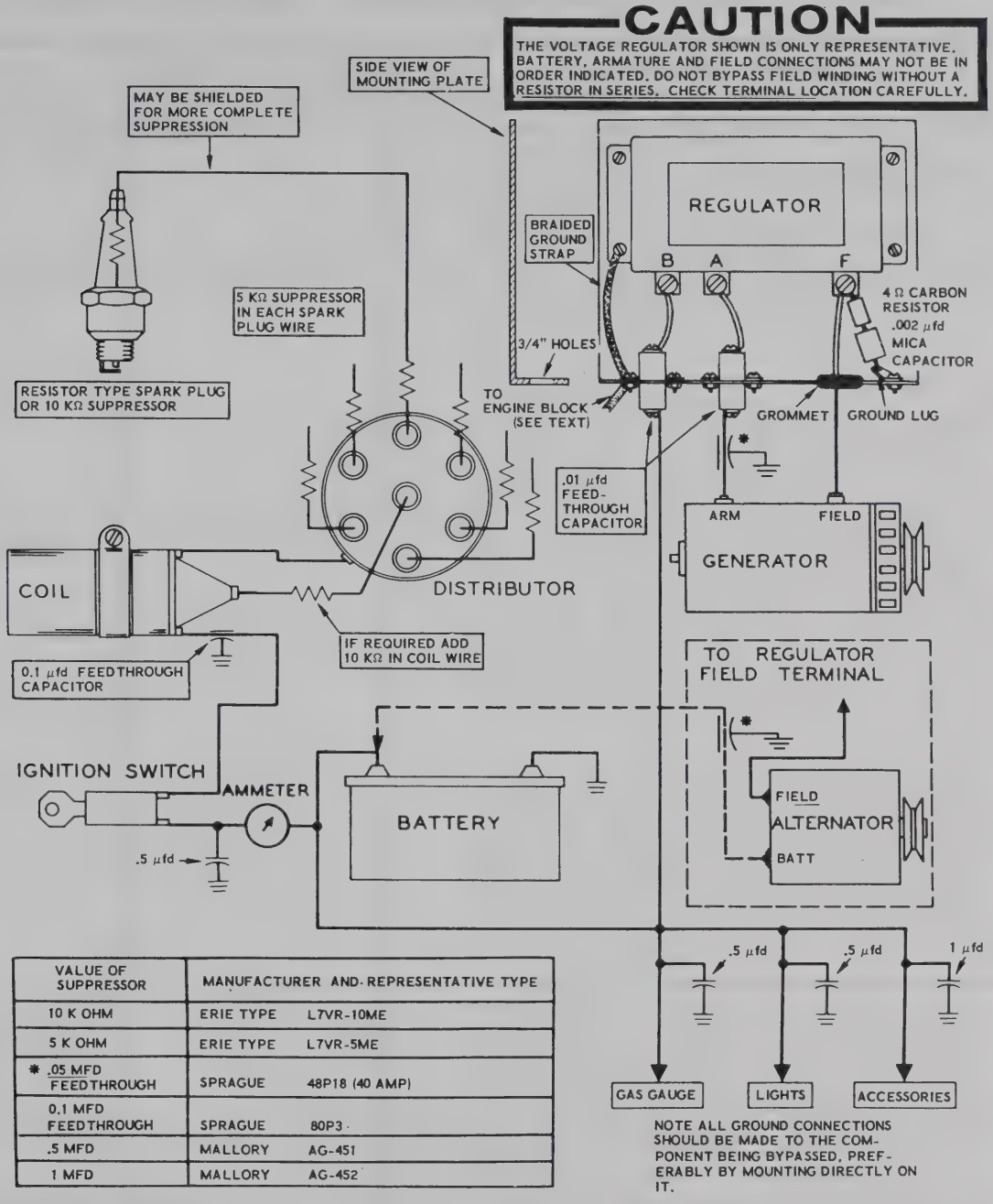
5. A distinct but irregular clicking noise, or "hash" as it is sometimes called, that disappears with the engine idling, indicates the voltage regulator is at fault.

6. A steady popping noise that continues with the ignition off indicates wheel or tire static interference. This is more pronounced on smooth roads.

7. The same type of interference as in step 6, but more irregular when on bumpy roads, particularly at slow speeds, indicates body static.

Refer to the Troubleshooting Chart on Page 105 and Figure 1-11 on Page 104 to help determine how to suppress most noise interference. Naturally, not all vehicles will require suppression to the extent shown in Figure 1-11, but some stubborn cases may require all the suppression components shown, plus shielding of the ignition system.

Bonding of various parts of the automobile, starting from the hood and continuing to the trunk, even including bonding of the transmission line every few feet from the antenna may be necessary.



VALUE OF SUPPRESSOR	MANUFACTURER AND REPRESENTATIVE TYPE
10 K OHM	ERIE TYPE L7VR-10ME
5 K OHM	ERIE TYPE L7VR-5ME
* .05 MFD FEEDTHROUGH	SPRAGUE 48P18 (40 AMP)
0.1 MFD FEEDTHROUGH	SPRAGUE 80P3
.5 MFD	MALLORY AG-451
1 MFD	MALLORY AG-452

Figure 1-11

NOISE SUPPRESSION TROUBLESHOOTING CHART

TYPE OF NOISE	POSSIBLE CAUSE	RECOMMENDED REMEDY
Loud popping increasing to buzz with increased engine speed.	Ignition system.	1. Replace plugs with resistor type. (Most recommended.) 2. Loose crimped connections should be cleaned and soldered. 3. Place resistors in distributor system.
Whine - varies with engine speed.	Generator.	1. 0.1 μfd coaxial type capacitor in series with the armature (A lead). 2. Clean commutator. 3. Replace brushes. 4. Ground generator shaft. 5. Parallel trap (#10 wire-coil and suitable capacitor) in series with armature lead, tuned to operating frequency.
Distinct but irregular clicking noise.	Voltage regulator.	1. 0.1 μfd coaxial type capacitor in series with the battery (B) and armature (A) leads. 2. A series combination of a .002 μfd mica capacitor and a 4 Ω carbon resistor to ground from the field (F) terminal. All components should be mounted as shown in diagram, close to voltage regulator.
Same as above.	Energy transfer to primary system.	1. Bypass at the following points: coaxial bypass in lead to coil from ignition switch (0.1 μfd). Battery lead to ammeter (.5 μfd); to gas gauge (0.5 μfd); to oil signal switch (0.5 μfd); head and tail light leads (.5 μfd); accessory wiring from engine compartment (.5 μfd).
Loud popping noise that changes from one type road to another. Most pronounced on concrete.	Wheel static.	1. Installation of front wheel static collectors (available from most automotive distributors). These should be checked every 5000 miles for excessive wear.
Same as above.	Tire static.	1. Injection of anti-static powder into tire through valve stem.
Irregular popping noise when on bumpy roads, particularly at slow speeds.	Body static.	1. Tighten all loose screws. 2. Use heavy flexible braid and bond the engine to the frame and fire wall. Bond the control rods, speedometer cable, exhaust pipes, etc., to the frame.

If an extensive amount of suppression is required, the engine should be retimed and tuned up at a reputable garage.

OPERATION

NOTE: YOU MUST HAVE AN AMATEUR RADIO OPERATOR AND A STATION LICENSE BEFORE PLACING THE TRANSMITTER SECTION OF THE TRANSCEIVER ON THE AIR. INFORMATION ABOUT LICENSING AND AMATEUR FREQUENCY ALLOCATIONS IS AVAILABLE FROM PUBLICATIONS OF THE FEDERAL COMMUNICATIONS COMMISSION OR THE AMERICAN RADIO RELAY LEAGUE.

Operation of the Transceiver has been simplified as much as possible to permit rapid adjustment by the operator. Once the initial settings have been made, it should not be necessary to readjust most of the controls. Read the following information carefully. Good operating techniques will provide good clean signals and long trouble-free life of the Transceiver.

CAUTION: Be sure a 50 to 75 Ω nonreactive load is connected to the ANT RF OUT jack before operating the Transceiver. This load can be an antenna, a dummy load, or a properly adjusted linear amplifier. (See the Installation section of the Manual on Page 100).

READING THE METER

Refer to Figure 1-12, and study the meter scale. Note how it reads for various positions of the Meter switch. Observe that the meter has two main scales and an ALC area.

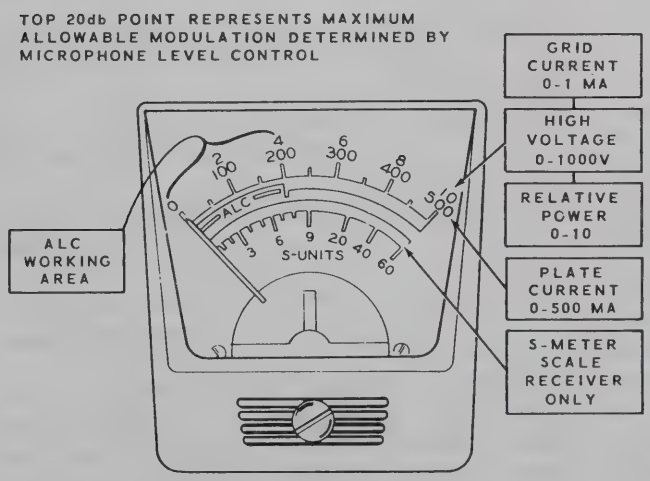


Figure 1-12

For receiver operation, the meter operates as an S-Meter and reads from 0 to 60, with the Meter switch in the ALC position.

For transmit operation, the scale numbered from 0 to 10 is read directly for relative power, 0 to 1 ma for grid current, and 0 to 1000 for high voltage indications. Read the 0 to 500 scale directly to read plate current in milliamperes.

RECEIVER SECTION

Connect an 8 Ω speaker to the 8 Ω SPEAKER jack, or plug a set of headphones into the PHONES jack.

1. Set the MODE switch to either LSB or USB.
2. Set the OSC MODE switch to LMO.
3. Turn the RF GAIN control to its fully clockwise position.

If an extremely strong station overloads the receiver front end, or if there are many weaker signals near the desired signal, leave the AF GAIN control set for comfortable listening; then adjust the receiver level with the RF GAIN control. This will keep the front end from overloading and masking the weaker signals that would otherwise interfere with the desired signal.

The S-Meter will move with adjustment of the RF GAIN control, but will still read correctly with the RF GAIN set at less than maximum, if the received signal level is high enough to register on the S-Meter. For example; if the RF GAIN control is set for a no-signal meter reading of S-5, and the meter registers S-9 with a signal, then the received signal is S-9.

4. Set the FUNCTION switch to PTT and allow the Transceiver to warm up.
5. Adjust the AF GAIN control clockwise until some receiver noise is heard.

NOTE: The AF GAIN control adjusts the overall receiver (speaker and headphones) volume. When headphones are used, set the HEADPHONE VOLume control to the same relative level as the speaker. Then regardless of whether a speaker or headphones are used, only the AF GAIN control need be changed for different volume levels.

6. The Transceiver is now ready to receive. Turn the BAND switch to select the desired 500 kc band segment. The frequency of the tuned signal is determined by adding together the settings of the BAND switch, the upper dial, and the circular dial.

7. Peak the DRIVER PRESELECTOR for maximum signal.

8. Turn the FUNCTION switch to CAL. Rotate the Main Tuning dial (LMO) to the nearest 100 kc point (0 on the circular dial).

 Adjust the Main Tuning dial until the calibrate signal is at zero beat. (To be sure that the correct calibrate signal is being used, check the DRIVE PRESELECTOR tuning. If the signal strength varies, you are tuned to the correct calibrator signal.)

WARNING: Some portions of each band are for CW operation only. Do not operate the transmitter (with modulation) in the VOX or PTT modes if the receiver is tuned to these portions of the bands and the OSC MODE switch is in the LMO position, or the transmitted signal will be outside of the phone part of the band. (When the OSC MODE switch is in the LMO position, the transmitter and receiver operate on the same frequency.)

TRANSMITTER SECTION

Initial Tune Up

The first 10 steps of this procedure must be performed for all modes of operation.

1. Set the BAND switch and Main Tuning dial for the desired frequency.

2. Place the METER switch in the PLATE position.

3. Turn the MIC/CW LEVEL control fully counterclockwise.

4. Set the OSC MODE switch to LMO. If crystal control of the transmitter is desired, set the OSC MODE switch to AUX T. (See the Special Crystal Considerations section of the Manual.)

5. With the RF load connected to the RF OUT jack, set the MODE switch to TUNE. The meter should read 50 ma.

CAUTION: For the following setups, do not leave the transmitter on at full output for extended periods of time or the final amplifier tubes and/or the power supply may be damaged.

6. Set the METER switch to REL PWR and adjust the FINAL loading control (lever knob) to 50.

7. Be sure the FINAL tuning (round knob) indicates the band segment of the band in use. IMPORTANT: Observe, while turning the MIC/CW LEVEL control clockwise, that the plate current and relative power readings reach a saturation point. Further increase in the setting of this control will show little or no increase in meter readings.

8. Turn the MIC/CW LEVEL control clockwise to obtain an up-scale indication on the meter. Then adjust the DRIVER PRESELECTOR, the FINAL tuning and FINAL loading controls for a maximum indication on the meter. Plate current should be approximately 250 ma with the MIC/CW LEVEL control set for maximum output.

9. Return the MIC/CW LEVEL control to its full counterclockwise position.

10. Place the MODE switch in the position for the desired mode of operation: USB, LSB, or CW.

CAUTION: The Transceiver should be retuned if the frequency is changed by any great amount. Be sure to readjust the FINAL tuning and loading controls. It may also be necessary to repeak the DRIVER PRESELECTOR control.

NOTE: The DRIVER PRESELECTOR peaks at slightly different position in transmit than in receive. For transceive operation it should be peaked on transmit.

This completes the Initial Tune Up. Before placing the Transceiver in operation, complete either the following CW or Single Sideband adjustments.

CW Operation

For CW operation the FUNCTION switch can be set to either the PTT or VOX positions. Even though CW operation is possible in the CALibrate position, it is not recommended because of possible spurious outputs.

NOTE: For 400 cps CW selectivity, the Heath SBA-300-2 CW crystal filter may be installed in place of the SSB crystal filter supplied in the Transceiver. No other circuit changes are required. However, with the CW crystal filter installed, it is not possible to transmit or receive SSB signals.

Be sure steps 1 through 10 have been satisfactorily completed before proceeding with the following adjustments.

11. Place the MODE switch in the CW position.

12. Plug a key into the CW KEY jack.

The VOX SENsitivity, ANTI-TRIP, and VOX DELAY controls are located on the control bracket under the cabinet cover.

13. While sending a series of "V's" adjust the VOX DELAY control so the relays stay energized between groups of characters. Clockwise rotation of this control will increase the holding time of the relays.

 The final setting of the VOX DELAY control will be determined by the sending speed of the operator. The slower the sending speed, the higher the setting of this control. NOTE: Be sure the VOX DELAY control is adjusted so the relays do not open after each character is sent.

14. Hold the key down and adjust the CW TONE VOLUME control for a comfortable monitoring level.

 NOTE: The frequency of the CW output signal is 1000 cycles higher than the dial reading. The received signal is actually in the USB position even though the MODE switch is set at CW. Consequently, cross-mode operation is possible between USB and CW without any resetting of the Main Tuning dial. For example, if two stations begin operation in the USB mode of operation and one operator changes to CW, the other station will hear a 1000 cycle note without retuning his receiver. Also, the station operating in the CW mode will receive the USB signal from the other station without changing back to the USB position of the MODE switch. When operating in the LSB mode, the operator changes to USB or CW, contact will be lost until the other station changes to either USB or CW.

15. Adjust the MIC/CW LEVEL control for approximately 1/2 scale grid current for CW operation.

Single Sideband Operation

Be sure steps 1 through 10 have been satisfactorily completed before proceeding with the following adjustments.

11. Set the MODE switch to either the USB or LSB position.

12. Set the BAND switch and the Main Tuning dial to the desired operating frequency.

13. Connect a microphone to the MIC connector.

14. Place the FUNCTION switch in the PTT position. (If your microphone does not have push-to-talk capabilities, make the VOX adjustments first, and then proceed with step 15.)

15. Set the METER switch to ALC.

16. Actuate the transmitter (PTT or VOX); and while speaking into the microphone, turn the MIC/CW LEVEL control clockwise until the peak deflections register at about S-6 on the meter. Do not allow the meter to deflect beyond the 20 db point.

NOTE: With the METER switch in the GRID position, there will be very little meter indication during voice operation.

VOX ADJUSTMENTS

() Turn the MIC/CW LEVEL control fully counterclockwise. Leave this control in this position for the following adjustments.

() Set the FUNCTION switch to VOX.

IN CASE OF DIFFICULTY

Refer to the Kit Builders Guide for Service and Warranty information.

A review of the Operation and Installation sections of the Manual may indicate any conditions overlooked.

NOTE: At no time should the LMO be opened or the Warranty will be voided. The LMO was aligned using the tube supplied. Changing this tube may cause some slight difference in calibration. Replace the tube with one of the same brand if replacement is necessary.

Refer to the Schematic Diagram (fold-out from Page 149) and to the Chassis Photos and X-Ray Views (Pages 144 to 149) for the location of parts.

Check the receiver and transmitter voltage readings against those shown in Figures 1-13A and 1-13B (fold-out from Page 110). Check the resistance readings against the readings shown in Figure 1-14 (fold-out from Page 111). All voltage readings were taken with an 11 megohm input digital voltmeter. Voltages may vary as much as 10%.

NOTE: Breaks in the foil of the circuit boards can easily be detected by placing a bright light under the foil side of the board and looking through the board from the lettered side. A break will appear as a hair-line crack in the foil.

Wiring errors and poor soldering are the most common causes of difficulty. Therefore, the first step in troubleshooting is to recheck all wiring against the Pictorials and Schematic diagrams. Often, having a friend check the wiring will locate an error consistently overlooked.

Quite often, soldered connections that appear good will have an insulating coating of rosin between the wire, the terminal, and the solder. This results from insufficient heat being applied when soldering. Many troubles can be eliminated by reheating each connection to make sure that it is properly soldered as illustrated in the Proper Soldering Techniques section of the Kit Builders Guide. The power cable should be removed from the power supply for such tests. As additional insurance against shock, a screwdriver blade should be used to short from the chassis to the red B+ wires.

If fuses blow instantly when power is applied to the unit, make resistance checks of the power supply, B+ circuits, and filament circuits. Check all tubes for possible shorts. Also refer back to the Initial Test section on Page 90. Check to be sure that all tubes are in their proper locations.

Be sure to read the Circuit Description so that "Cause-and-Effect" reasoning may be employed as the search for the trouble progresses. If some difficulty still persists after the steps outlined in the Troubleshooting Chart have been completed, try to localize the trouble to a particular stage in the circuit by using the voltage and resistance charts. Then refer to the Block Diagram and Schematic to visualize circuit relationships.

A VTVM will be needed to measure voltages. Most of the RF voltages can be measured with the aid of an RF probe.

A grid dip meter or wavemeter and a general coverage receiver are ideal instruments for checking operation of the RF circuits.

NOTE: If there is instability in the unit, check all circuit board mounting screws. These screws should be tight to the chassis and to the circuit board. Be sure lockwashers are against the foil side of the boards for good grounding.

The sealed relays used in this unit will be troublefree for years of normal use.

DO NOT REMOVE ANY OF THE TUBES OR PILOT LAMPS WITH POWER APPLIED TO THE UNIT. Because of the series-parallel filament circuit arrangement when using a 12 volt supply, removing the tube with power applied may destroy other tubes due to an increase in filament current through them.

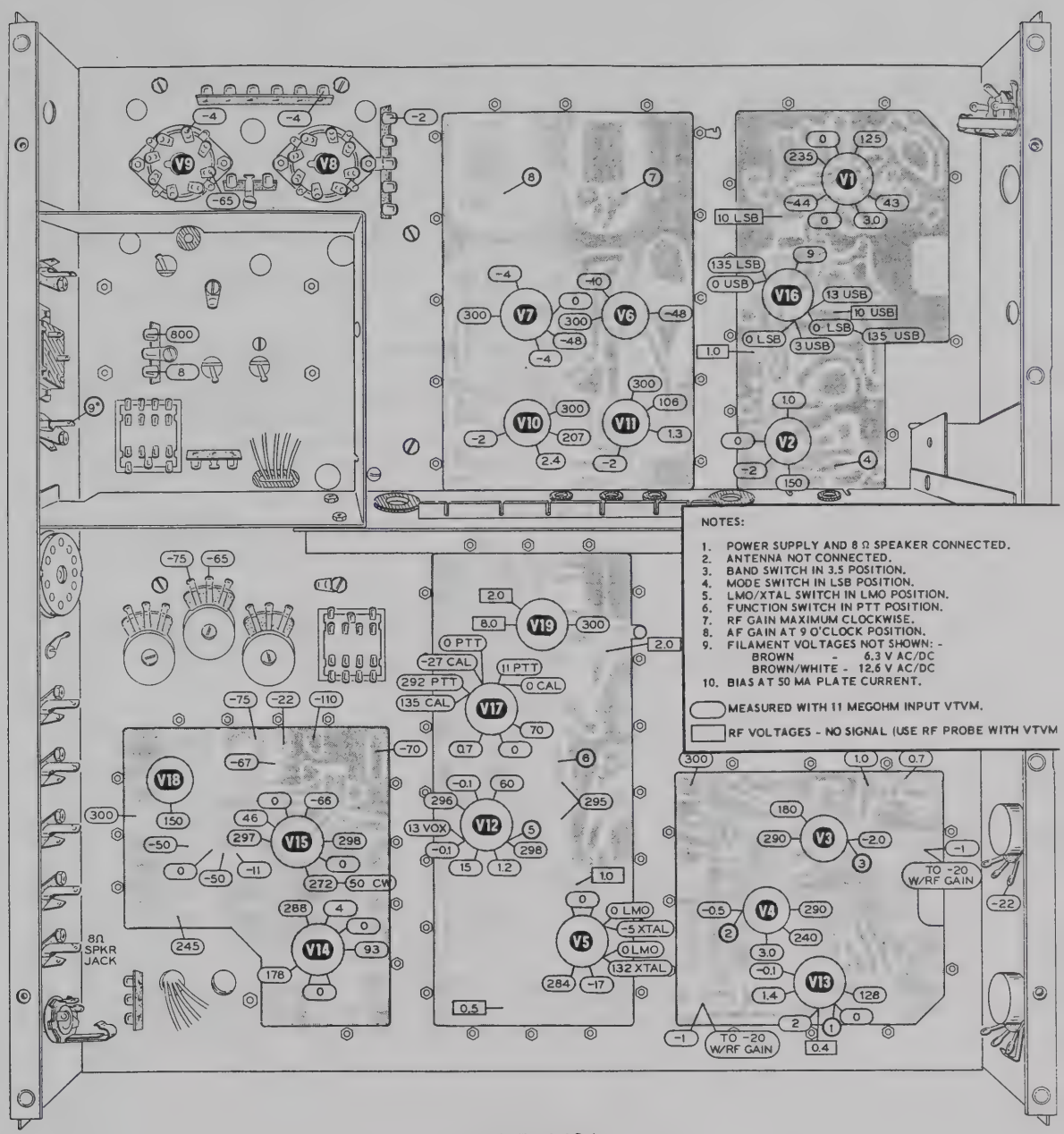


FIGURE 1-13A
RECEIVER DC VOLTAGE CHART

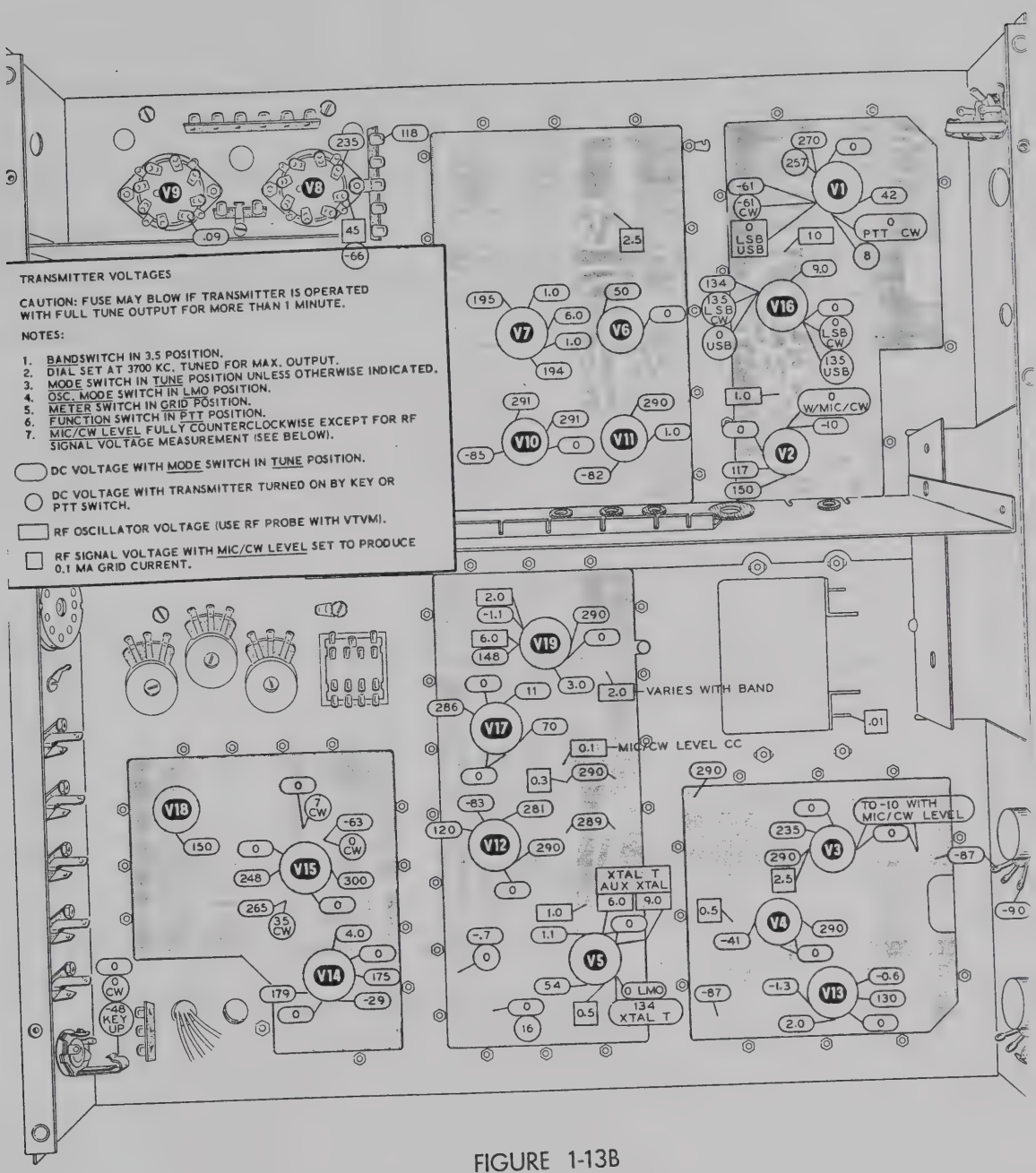


FIGURE 1-13B

TRANSMITTER VOLTAGE CHART

(Refer to Receiver DC Voltage Chart)

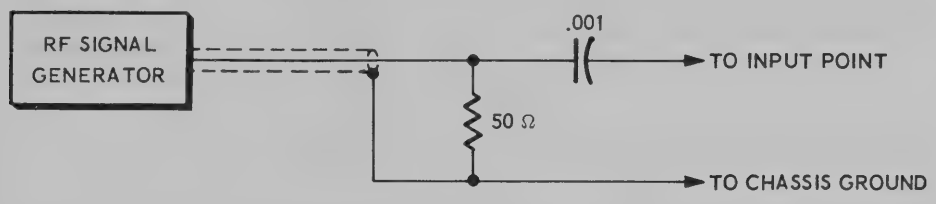
NOTES:

CONTROL AND SWITCH SETTINGS AS IN DC VOLTAGE CHART EXCEPT AS FOLLOWS:

1. DIAL FREQUENCY - 3.895 MC.
2. MODE SWITCH - LSB OR USB.
3. AF GAIN - SET TO HEAR SIGNAL WITH APPROXIMATELY 1000 CPS TONE.
4. METER SWITCH IN ALC POSITION.

◯ SIGNAL INPUT POINTS.

SIGNAL GENERATOR TERMINATION



INPUT POINT	INPUT FREQUENCY	INPUT LEVEL	VTVM OR S-METER READING
1	3.395 MC	20 MV	(AF GAIN MAX. CLOCKWISE) 4 V RMS AT 8 Ω JACK
2	"	10 MV	S-4
3	"	10 MV	S-9 + 60 DB.
4	"	10 MV	S-9 + 60 DB.
5	"	10 MV	S-9 + 10 DB.
6	8.5 MC	10 MV	S-9 + 40 DB.
7	3.895 MC	10 MV	S-9 + 20 DB.
8	3.895 MC	10 MV	S-9 + 40 DB PEAK DRIVER PRESELECTOR
XTAL CAL ON	3.900 MC	100 μV	S-9 + 20 DB PEAK DRIVER PRESELECTOR
9*	3.900 MC		S-9 APPROXIMATLY

* GENERATOR CONNECTED DIRECTLY - NO TERMINATION.

RECEIVER SIGNAL VOLTAGE CHART

(Refer to Receiver DC Voltage Chart)

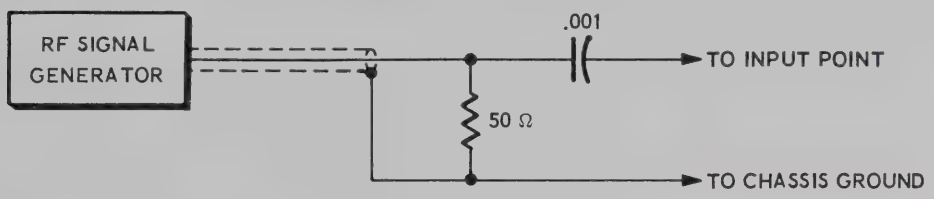
NOTES:

CONTROL AND SWITCH SETTINGS AS IN DC VOLTAGE CHART EXCEPT AS FOLLOWS:

1. DIAL FREQUENCY - 3.895 MC.
2. MODE SWITCH - LSB OR USB.
3. AF GAIN - SET TO HEAR SIGNAL WITH APPROXIMATELY 1000 CPS TONE.
4. METER SWITCH IN ALC POSITION.

○ SIGNAL INPUT POINTS.

SIGNAL GENERATOR TERMINATION



INPUT POINT	INPUT FREQUENCY	INPUT LEVEL	VTVM OR S-METER READING
1	3.395 MC	20 MV	(AF GAIN MAX. CLOCKWISE) 4 V RMS AT 8 Ω JACK
2	"	10 MV	S-4
3	"	10 MV	S-9 + 60 DB.
4	"	10 MV	S-9 + 60 DB.
5	"	10 MV	S-9 + 10 DB.
6	8.5 MC	10 MV	S-9 + 40 DB.
7	3.895 MC	10 MV	S-9 + 20 DB.
8	3.895 MC	10 MV	S-9 + 40 DB PEAK DRIVER PRESELECTOR
XTAL CAL ON	3.900 MC	100 μV	S-9 + 20 DB PEAK DRIVER PRESELECTOR
9*	3.900 MC		S-9 APPROXIMATLY

* GENERATOR CONNECTED DIRECTLY - NO TERMINATION.

RECEIVER SIGNAL VOLTAGE CHART

NOTE: Close-talk into the microphone when using VOX operation to prevent background noise from tripping the Transceiver into transmit operation.

() While speaking into the microphone, turn the VOX SENsitivity control to just beyond a setting that will energize the relays. Be sure this control is not set so high that it will allow background noise to trip the relays.

() Tune the receiver to a fairly strong signal and adjust the AF GAIN control for a comfortable listening level.

() Place the microphone where it will normally be used, Advance the ANTI-TRIP gain control to just beyond a setting that will keep the speaker signal from tripping the relays (through the microphone and VOX circuits). Be sure this control is not set so high that it completely disables the relay closing action.

() While speaking into the microphone, turn the VOX DELAY control to a setting that will hold the relays energized during the slight pauses between words. This prevents the relays from tripping at the beginning and end of each word.

NOTE: There will be a slight interaction between the VOX SENsitivity, ANTI-TRIP, and VOX DELAY controls. Consequently, it may be necessary to readjust these controls slightly to achieve the desired results.

The Transceiver is now ready for transmit operation in the SSB mode. Speaking into the microphone (VOX) or using the microphone push-to-talk switch (PTT) will change the Transceiver from receive to transmit operation. Remember, as long as the OSC MODE switch is in the LMO position, the receiver and transmitter are locked on the same frequency.

OPERATION WITH A LINEAR AMPLIFIER

Operation with a linear amplifier is similar to operation with an antenna at the output of the Transceiver, except that the linear amplifier input may have a different impedance. This will make it necessary to adjust the FINAL Tuning and Loading controls for maximum output (input to the linear amplifier). Figure 1-10 shows the proper connections between a linear amplifier and the Transceiver.

MOBILE OPERATION

If the Heathkit Model HP-13 Power Supply is to be used with the Transceiver in a mobile installation, and the BIAS control in the Transceiver has already been preset for fixed station operation, make the following adjustments.

() Turn the MIC/CW LEVEL control fully counterclockwise.

() Place the MODE switch in either the USB or LSB position.

() Set the FUNCTION switch to PTT.

() Place the METER switch in the PLATE position.

NOTE: The following adjustment should be made with the automobile engine running at about a 30 mph speed so the generator is charging.

Activate the transmitter with the push-to-talk button on the microphone, and adjust the bias control in the HP-13 Power Supply for a plate current reading of 50 ma. This will make it unnecessary to readjust the BIAS control of the Transceiver each time it is changed from mobile to fixed station use.

The VOX SENsitivity, VOX DELAY, and ANTI-TRIP gain circuits will operate in mobile use, but because of the different power supplies, it may be necessary to readjust these controls. For VOX operation, leave clearance in the mobile installation so the Transceiver cover can be opened to make these adjustments.

Transmitter loading may be somewhat more critical on mobile antennas because of their sharper frequency characteristics. Consequently, the mobile antenna must be tuned as closely as possible to the desired operating frequency with the lowest possible SWR (standing wave ratio).

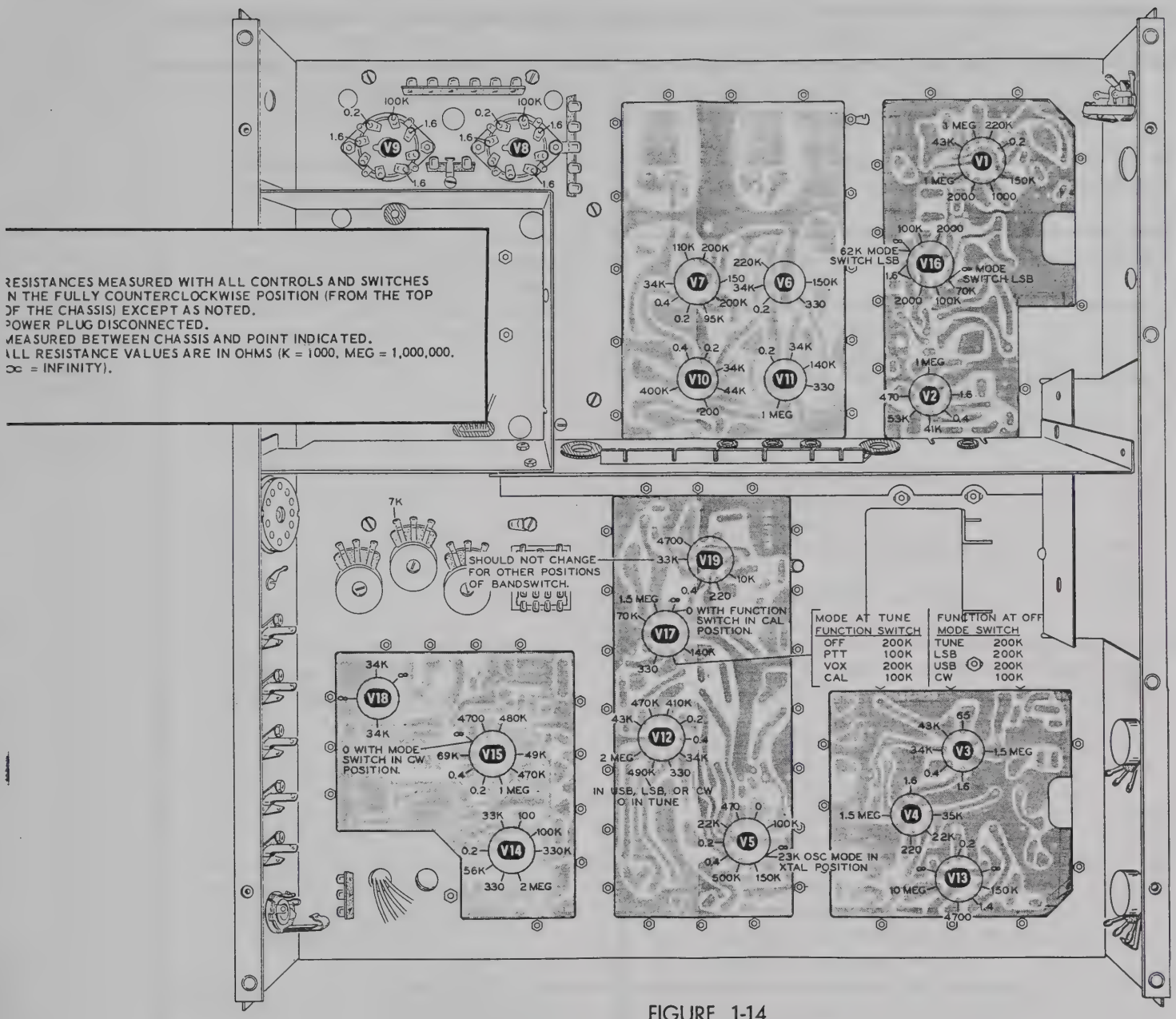


FIGURE 1-14
RESISTANCE CHART

SYMPTOMS	POSSIBLE CAUSE
7. Regulated B+ voltage too low.	A. Check items 5B and 6B. B. Shorted bypass capacitor in regulated B+ line.
8. No screen voltage at tubes V10 and V11.	A. Lugs 3, 7, or 11 of relay RL2 wired wrong.
9. High-pitched audio oscillation unaffected by AF GAIN control.	A. Red and blue audio output transformer leads reversed.
10. No audio output from speaker or headphones.	A. Check items 5A, 5B, and 5C. B. Defective transformer T301. C. PHONE VOLUME control wrong value, shorted, or wired backwards. D. Filter capacitor C304 shorted or installed backwards. E. Audio amplifier output tube V14 defective. F. Coaxial cables connected to AF GAIN control shorted. G. Leads reversed at lugs 3, 7, or 11 of relay RL2. H. Leads reversed at lugs 2, 6, or 10 of relay RL2.
11. No audio output from speaker, but headphone output OK.	A. Contacts 1 and 2 of PHONES jack open. B. Leads reversed to lugs 1 and 4 of PHONES jack. C. Speaker lead connected to wrong phono socket. D. Defective speaker. E. Output transformer green, black, or white leads connected wrong.
12. Low or no audio output from headphones, but speaker output OK.	A. PHONE VOLUME control set to its full counterclockwise position. B. PHONES jack wired incorrectly. C. Defective headphones.
13. No signal or noise output, but very low hum output can be heard (speaker or phones).	A. Check items 10A, 10F, and 10G. B. RFC101 open. C. Product detector tube V13 faulty. D. No carrier generator injection signal at product detector. (Check items 30A through 30F.) E. Red coaxial cable connected to AF GAIN control open or shorted. F. IF transformer T102 misaligned or defective. G. IF amplifier tubes V3 or V4 defective. H. Orange coaxial cable from V12 to crystal filter FL1 open or shorted. I. RF GAIN control wired backwards.

SYMPTOMS	POSSIBLE CAUSE
14. No signal output, but noise output can be heard.	A. Transformer T201 misaligned or defective. B. No LMO injection signal at the cathode of V12A. (Check items 31A through 31E.) C. Coaxial cable connected between the bandpass and driver plate circuit boards, open or shorted. D. First IF amplifier tube V3 defective. E. Second receiver mixer tube V12A defective. F. No heterodyne oscillator injection signal at the cathode of V11. (Check items 33A through 33I.) G. First receiver mixer V11 or RF amplifier V10 defective. Also check item 4A. H. Coaxial cable connected between relay RL1 and the driver plate circuit board, open or shorted. I. Relay RL1 or ANTENNA switch wired incorrectly. J. Bandpass filter T202 defective. K. Crystal filter FL1 defective.
15. Audio output with signal, but weak.	A. Low B+ supply voltage. B. Coils on driver plate, driver grid, and heterodyne oscillator circuit boards misaligned. C. Check items 4A, 7A, 13A through 13I and 14A through 14K. D. RF GAIN control is partially counterclockwise or wired incorrectly.
16. Receiver tends to be unstable, oscillates. (Receiver noise may be extremely high, or many "birdies" appear across tuning range.)	A. RF driver and IF circuit board mounting hardware not tight, or lockwashers left out between the chassis and circuit boards. B. Antenna transmission line open or shorted, or has high SWR. C. Supply voltage too high. Check items 6A and 6B. D. Transmitter cut-off bias too low.
17. Sideband reception reversed or highly distorted.	A. Carrier generator crystals Y1 and Y2 interchanged. B. CW carrier generator crystal Y3 interchanged with either Y1 or Y2. C. Leads reversed at lugs 13 and 17 on the OSC MODE switch.

SYMPTOMS	POSSIBLE CAUSE
18. S-Meter inoperative, indicates backwards, is inoperative in some METER switch positions, or does not zero.	A. Leads connected to the meter are reversed. B. Improper wiring of METER switch. C. METER ZERO control improperly adjusted. D. One of the following resistors is a wrong value: R103, R105, R106, R107, R110, or R115. E. First or second IF amplifier tubes (V3 or V4) defective. F. AVC line shorted to chassis. G. Lugs 4, 8, or 12 of relay RL2 wired wrong. H. V19, wrong type.
19. No screen voltage at driver tube V7.	A. Relay RL2 not energized. Check items 34A through 34C, and 35A through 35H. B. Lugs 3, 7 , and 11 of relay RL2 connected incorrectly.
20. Bias voltage does not shift to operating levels in transmit conditions.	A. Check item 19A. B. Lugs 2, 6, and 10 of relay RL2 wired wrong. C. BIAS ADJUST control set improperly.
21. No RF output from final, regardless of MODE switch position. (Driver output appears to be OK.)	A. No high voltage B+ at the plates of final amplifier tubes V8 and V9. B. RF choke L901 open. C. Lugs 8 and 12 of relay RL1 wired wrong. D. Bias voltage too high at the grids of V8 and V9. (Check items 20A through 20C.) E. FINAL controls not adjusted properly. F. Final amplifier tubes V8 and/or V9 defective. G. Rotor in switch on driver plate circuit board 180 degrees out of rotation. H. Final knobs or shafts loose.
22. No RF output from driver regardless of MODE switch position. (Second transmitter mixer appears to be OK.)	A. No B+ voltage at the screen of V7. (Check items 19A and 19B.) B. RFC801 open. C. Bias voltage at grids of V8 and V9 too high. Check items 19A, 20B, and 20C. D. Coils on the driver plate and grid circuit boards misaligned. E. DRIVER PRESELECTOR control not adjusted properly. F. Driver tube V7 defective.

SYMPTOMS	POSSIBLE CAUSE
23. No RF output from second transmitter mixer, regardless of the MODE switch setting. (First transmitter mixer appears to be OK.)	A. Check items 5A through 5C, 19A, 19B, 22D, and 22E. B. No heterodyne oscillator injection signal at cathode of V6. (Check items 33A through 33K.) C. Coaxial cable connected between the bandpass and driver plate circuit board open or shorted. D. Second transmitter mixer tube V6 defective.
24. No output from first transmitter mixer regardless of the MODE switch position. (First IF amplifier appears to be OK.)	A. OSC MODE switch in wrong position. B. Check items 19A, 19B, 20B, 20C, 22D, and 22E. C. No LMO output signal to cathode of V5 (pin 7). D. First transmitter mixer tube V5A defective. E. Blue coaxial harness cable connected between the IF and bandpass coupler circuit boards open or shorted. F. Capacitors C111 and C402 wrong value. G. Bandpass filter T202 defective.
25. No RF output from first IF amplifier, regardless of the MODE switch position. (Isolation amplifier output appears to be OK.)	A. Check items 14A, 14C, 14D, 14K, 19A, and 19B.
26. No RF output from isolation amplifier, regardless of the MODE switch position.	A. Check items 20B and 20C. B. Resistors R18, R19, R23, R24, R937, and/or R938 wrong value. C. Transformer T1 misaligned or faulty. D. Isolation amplifier tube V2 defective. E. Carrier oscillator not operating. (Check items 29B through 29E, and 30B through 30E.)

SYMPTOMS	POSSIBLE CAUSE
27. No RF output with the MODE switch in USB or LSB, but output in Tune or CW positions OK.	A. Check items 10C, 10D, 10E, 20A, and 25A. B. No carrier injection signal to balanced modulator. (Check items 29B through 29E, and 30B through 30E.) C. Balanced modulator diodes CR1 through CR4, installed improperly, wrong type, or defective. D. Orange and/or yellow coaxial cables connected to the MIC/CW LEVEL control open or shorted. E. Wafer 1F or 1R of the MODE switch wired incorrectly. F. MIC connector wired wrong. G. Speech amplifier tube V1 defective. H. Microphone defective. I. MIC/CW LEVEL control defective.
28. No RF output with the MODE switch in TUNE or CW, but output in LSB or USB OK.	A. Check items 19A, 19B, 20B, 20C, 29B, 29C, 29D, and 29E. B. MIC/CW LEVEL control defective. C. Rear wafer of MODE switch wired wrong.
29. No carrier oscillator injection signal with the MODE switch in TUNE or CW positions, but LSB and USB output OK.	A. Check items 19A and 19B. B. CW crystal Y3 improper frequency or defective. C. Lugs 1, 5, and/or 9 of the MODE switch wired incorrectly. D. Incorrect wiring of MODE switch wafers 1F or 2R. E. Tube V16 defective.
30. No carrier oscillator injection signal with the MODE switch in either LSB or USB positions. TUNE and CW output OK.	A. Check items 19A and 19B. B. Black coaxial cable from IF circuit board to modulator circuit board shorted. C. USB crystal Y1, or LSB crystal Y2, improper frequency or defective. D. Capacitors C4 through C8, C16 and C17, wrong value. E. Resistors R6 through R9, or R11, wrong value. F. Tube V16 defective.

SYMPTOMS	POSSIBLE CAUSE
31. No LMO injection signal at cathodes of V5 or V12.	A. Check items 5A, 5B, and 5C. B. OSC MODE switch not in the LMO position, or wired wrong. C. The violet, orange, or white coaxial cables connected to the OSC MODE switch, or the coaxial cable between the OSC MODE switch and the LMO, wired incorrectly, shorted, or open. D. LMO tube V20 defective. NOTE: If this tube has to be replaced, use a tube from the same manufacturer. E. Defective LMO unit. If after making all the above checks it is determined that the LMO unit is defective, return the complete LMO to the Heath Company. See Page 15 of the Kit Builders Guide.
32. LMO frequency does not shift properly with MODE switch in various positions.	A. Check items 2A, 2B, 2C, 5A, 5B, 5C, 29B, 29D, 30C, 31D, and 31E. B. MODE switch wafer 1F wired incorrectly. C. Resistor R306 or R307 wrong value.
33. No heterodyne oscillator injection signal at cathodes of V6 and V11.	A. Check items 5A, 5B, and 5C. B. One of the crystals Y501 through Y508 defective, depending on the band being used. C. Red coaxial cable from heterodyne oscillator circuit board to bandpass circuit board, open or shorted. D. Capacitors C208 or C223 wrong value. E. Tube V19 defective or wrong type. F. Coils L601 through L608 misaligned or faulty. G. Capacitor C604 wrong value. H. No 150 V B+ voltage to the heterodyne oscillator circuit board. I. Rotors reversed 180 degrees in the switch wafer on the crystal or heterodyne oscillator circuit boards.
34. Relays RL1 and RL2 do not energize with the MODE switch in the TUNE position.	A. Tube V12B defective. B. Relays RL1 or RL2 defective. C. Wafer 2F of MODE switch wired incorrectly.

SYMPTOMS	POSSIBLE CAUSE
35. Relays RL1 and RL2 will not energize with MODE switch in LSB or USB, and FUNCTION switch in VOX position.	A. Check items 10C, 10D, 10E, 27G through 27J, 34A, 34B and 34C. B. VOX SENSITIVITY control improperly adjusted. C. Tube V17A defective or wrong type. D. Diode D201 wrong type or installed backwards. E. Zener diode D202 installed backwards or defective. F. FUNCTION switch wired incorrectly. Check the red-red-white wire to lug 3. G. ANTI-TRIP control set too high. H. FUNCTION switch in the CAL position.
36. Relays energize and stay energized regardless of VOX SENsitivity control setting.	A. Check items 34B, 35D, and 35E. B. Anti-trip rectifiers D1 and D2 installed backwards. C. PTT switch on microphone stuck closed or shorted. D. Key closed.
37. Transmitter tends to be unstable.	A. Final and/or driver neutralization not proper. B. Mounting hardware for DRIVER PRESELECTOR capacitor not tight. C. Mounting hardware for Modulator and RF driver circuit board not tight. Lockwashers between circuit boards and chassis left out. D. Check items 16C and 16D. E. Coils L802 through L805 and/or L801 misaligned. F. Antenna impedance wrong. G. Coil shield cover loose. H. Ground clips for tube shields bent out.
38. Receiver has slow recovery from transmit condition.	A. Diode D101 defective.
39. Grid drive falls off.	A. Excessive heat due to restricted air circulation. B. Incorrect bias setting. C. Improper load to RF output. D. Gassy 6146 tubes.
40. Zero setting of main tuning dial changes considerably from band to band.	A. 100 kc calibrator is not set exactly at 100 kc.

SPECIFICATIONS

RECEIVER

Sensitivity	Less than 1 microvolt for 15 db signal-plus-noise to noise ratio for SSB operation.
SSB Selectivity	2.1 kc minimum at 6 db down, 5 kc maximum at 60 db down (3.3395 mc filter). (2:1 nominal shape factor at 60:6 db.)
Input	Low impedance for unbalanced coaxial input.
Output Impedance	8 and 600 Ω speaker, and high impedance headphone.
Power Output	2 watts with less than 10% distortion.
Spurious Response	Image and IF rejection better than 50 db. Internal spurious signals below equivalent antenna input of 1 microvolt.

TRANSMITTER

DC Power Input	SSB: (A3a emission) 180 watt P.E.P. (normal voice: continuous duty cycle). CW: (A1 emission) 170 watts (50% duty cycle).
RF Power Output	100 watts on 80 through 15 meters; 80 watts on 10 meters (50 Ω nonreactive load).
Output Impedance	50 Ω to 75 Ω with less than 2:1 SWR.
Oscillator Feedthrough Or Mixer Products	55 db below rated output.
Harmonic Radiation	35 db below rated output.
Transmit-Receive Operation	SSB: PTT or VOX. CW: Provided by operating VOX from a keyed tone, using grid-block keying.
CW Side-Tone	Internally switched to speaker or headphones, in CW mode. Approximately 1000 cps tone.
Microphone Input Impedance	High impedance.
Carrier Suppression	50 db down from single-tone output.
Unwanted Sideband Suppression	55 db down from single-tone output at 1000 cps reference.
Emissions not possible or not recommended	A0, A2, A3, A3b, A4 through A9, F0 through F9, and P0 through P9.

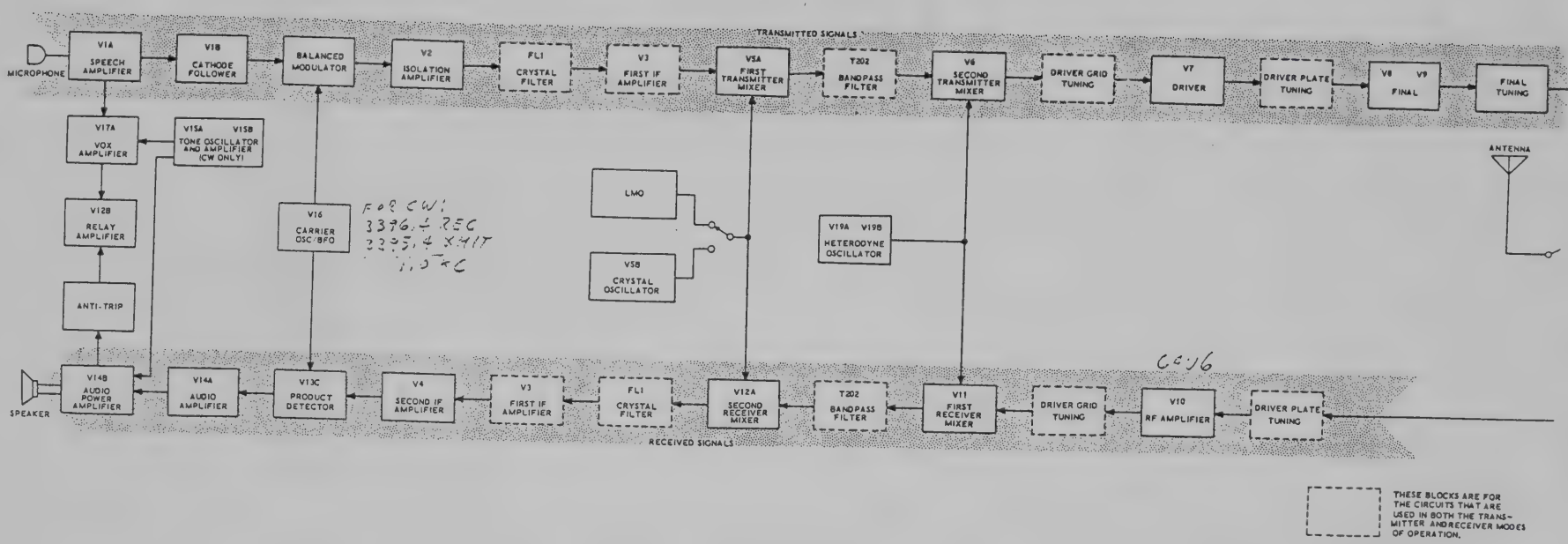
Third Order Distortion.	30 db down from two-tone output.
RF Compression (TALC*).	10 db or greater at .1 ma final grid current.

GENERAL

Frequency Coverage.	3.5 to 4.0; 7.0 to 7.3; 14.0 to 14.5; 21.0 to 21.5; 28.0 to 28.5; 28.5 to 29.0; 29.0 to 29.5; 29.5 to 30.0 (megacycles).
Frequency Stability.	Less than 100 cps per hour after 20 minutes warmup from normal ambient conditions. Less than 100 cps for ±10% line voltage variations.
Modes Of Operation.	Selectable upper or lower sideband (suppressed carrier) and CW.
Visual Dial Accuracy.	Within 200 cps on all bands.
Electrical Dial Accuracy.	Within 400 cps after calibration at nearest 100 kc point.
Dial Mechanism Backlash.	Less than 50 cps.
Calibration.	100 kc crystal.
Audio Frequency Response.	350 to 2450 cps.
Phone Patch Impedance.	8 Ω or 600 Ω receiver output to phone patch; high impedance phone patch input to transmitter.
Front Panel Controls.	Main (LMO) tuning dial. Driver tuning and Preselector. Final tuning. Final loading. Mic and CW Level control. Mode switch. Band switch. Function switch. Osc Mode switch. Meter switch. RF Gain control. Audio Gain control.

Internal Controls.	VOX Sensitivity. VOX Delay. ANTI-TRIP. Carrier Null (control and capacitor). Meter Zero control. CW tone volume. Relative Power Adjust control. Bias. Phone Vol (headphone volume). Neutralizing.
Tube Complement.	OA2 Regulator (150 V). 6AU6 RF amplifier. 6AU6 1st receiver mixer. 6AU6 Isolation amplifier. 6AU6 1st IF amplifier. 6AU6 2nd IF amplifier. 6BN8 Product detector and AVC. 6BZ6 LMO. 6CB6 2nd transmitter mixer. 6CL6 Driver. 6EA8 Speech Amplifier and cathode follower. 6EA8 1st transmitter mixer and crystal oscillator. 6EA8 2nd receiver mixer and relay amplifier. 6EA8 CW side-tone oscillator and amplifier. 6GW8 Audio amplifier and audio output. 12AT7 Heterodyne oscillator and cathode follower. 12AT7 VOX amplifier and calibrator oscillator. 12AU7 Sideband oscillator. 6146 Final amplifiers (2).
Diode Complement.	6 Germanium Diodes; Balanced modulator, RF sampling, and crystal calibrator harmonic generation. 9 Silicon Diodes: ALC rectifiers, anti-trip rectifiers, and DC blocking. 1 Zener Diode: cathode bias.

BLOCK DIAGRAM



Rear Apron Connections.	CW Key jack. 8 Ω output. 600 Ω output. Phone patch input. ALC input. Power and accessory plug. RF output. Antenna switch. Receiver Antenna. Spare.
Power Requirements.	700 to 850 volts at 250 ma with 1% maximum ripple. 300 volts at 150 ma with .05% maximum ripple. -115 volts at 10 ma with .5% maximum ripple. 12 volts AC/DC at 4.76 amps.
Cabinet Dimensions.	14-7/8" wide x 6-5/8" high x 13-3/8" deep.
Net Weight.	17-1/2 lbs.
Equipment Used To Prepare Specifications.	Heath HN-31 "Cantenna." Heath HO-10 Monitorscope. Heath IM-11 VTVM. Heath MM-1 VOM. Heath IG-72 Audio Generator. Heath HDP-21 Microphone. Hewlett-Packard Electronic Counter, Model 524B. Tektronix Oscilloscope, Model 581A. Hewlett-Packard Signal Generator, Model 606A. Panoramic Radio Products Inc., "Panalyzor," Model SB-12A. Boonton RF Voltmeter, Model 91-CA. Dynascan Digital Voltmeter, Model 111.

All prices are subject to change without notice. The Heath Company reserves the right to discontinue instruments and to change specifications at any time without incurring any obligation to incorporate new features in instruments previously sold.

CIRCUIT DESCRIPTION

Refer to the Block Diagram (fold-out from Page 122) and to the Schematic (fold-out from Page 149) while reading this Circuit Description. Small sections of the Schematic are also included in this Description to make the circuits easier to follow.

Note that the receiver circuits are across the bottom, and the transmitter circuits are across the top of the Schematic and Block Diagrams. Also, several of the circuits that are used for transmitting are also used for receiving (such as the crystal filter and the first IF amplifier). These circuits, which are shown in both the transmitter and receiver portions of the Block Diagram, are identified in the Block Diagram by dotted lines.

Each rotary switch wafer is identified by the front panel name of the switch, and by a letter-number designation that shows the position of that wafer in the switch. See Figure 2-1.

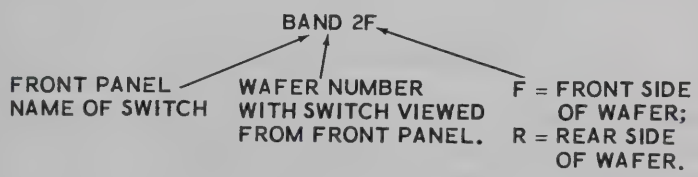


Figure 2-1

Letter number designations for the resistors, capacitors, coils, etc., are placed in the following groups:

0- 99	Parts on modulator circuit board.
100-199	Parts on IF circuit board.
200-299	Parts on bandpass circuit board.
300-399	Parts on audio circuit board.
400-499	Parts on RF-driver circuit board.
500-599	Parts on crystal circuit board.
600-699	Parts on heterodyne oscillator circuit board.
700-799	Parts on driver grid circuit board.
800-899	Parts on driver plate circuit board.
900-999	Parts mounted on the chassis.

TRANSMITTER CIRCUITS

The chart in Figure 2-2 lists the various frequencies that will be found throughout the transmitter on each band. The transmitted lower sideband frequency of 3.895 mc, modulated with a 1400 cycle audio tone, which is shown on the first line, will be used when tracing through the transmitter circuits. The other frequencies referred to in this Circuit Description will also be found on the first line.

BAND	CARRIER OSCILLATOR (3393.6 kc plus 1400 cps modulation), CRYSTAL FILTER AND IF FREQUENCIES	LMO FREQUENCY (BETWEEN 5 AND 5.5)	SIGNAL FREQUENCY AT BANDPASS FILTER (BETWEEN 8.395 AND 8.895)	HETERODYNE OSCILLATOR FREQUENCY (CRYSTAL FIXED)	TRANSMITTED SIGNAL FREQUENCY
3.5 to 4	3.395	5.105	8.5	12.395	3.895
7 to 7.5	3.395	5.3	8.695	15.895	7.2
14 to 14.5	3.395	5.3	8.695	22.895	14.2
21 to 21.5	3.395	5.2	8.595	29.895	21.3
28 to 28.5	3.395	5.4	8.795	36.895	28.1
28.5 to 29	3.395	5.3	8.695	37.395	28.7
29 to 29.5	3.395	5.3	8.695	37.895	29.2
29.5 to 30	3.395	5.4	8.795	38.395	29.6

All frequencies are in mc.

Figure 2-2

3393.6
1.4
3395.0



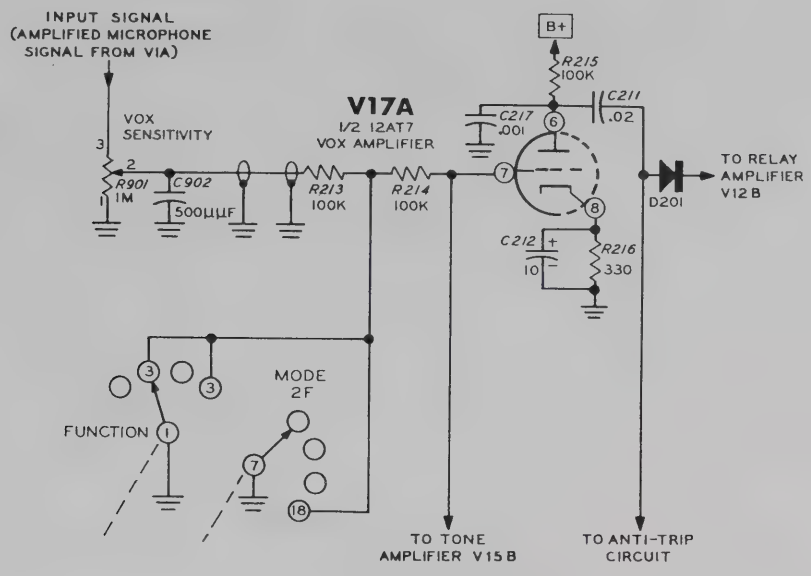


Figure 2-3

VOX Amplifier (Figure 2-3)

The Transceiver can be switched from receive to transmit by either the VOX (voice operated transmitter) or the push-to-talk method. The VOX circuit works in the following manner:

The audio signal from the microphone is coupled through speech amplifier V1A and capacitor C9 to the VOX Sensitivity control. From the arm of this control, for VOX operation, the signal is coupled through resistors R213 and R214 to the grid of VOX amplifier V17A. The signal is amplified in V17A. It is then coupled through capacitor C211, rectified by diode D201, and applied to relay amplifier V12B, which actuates the transmit-receive relays.

In the PTT and Calibrate positions of the Function switch, and in the CW position of the Mode switch, the lead from the VOX Sensitivity control to the grid of V17A is connected to ground. This keeps stray microphone signals from activating the VOX circuit during PTT and CW operation, or during calibration.

Relay Amplifier (Figure 2-4)

Relay amplifier V12B is held in cutoff durin receive operation by the positive voltage tha is maintained at its cathode by zener diod D202. V12B is made to conduct for transmit op eration by the VOX voltage at its grid, or b the push-to-talk switch on the microphon which shorts the cathode to ground. (The cathod of V12B is also shorted to ground by wafer 2 of the Mode switch in the Tune position. Diode D201 rectifies the audio signal from th VOX amplifier so that a positive voltage ap pears at the grid of relay amplifier V12B. Th positive voltage at the grid causes the rela amplifier to conduct, and the plate curren of V12B causes relays RL1 and RL2 to clos and place all circuits in the transmit mode o operation.

The VOX hold-in time is adjusted by varying th discharge time for capacitor C213 with the VO Delay control.

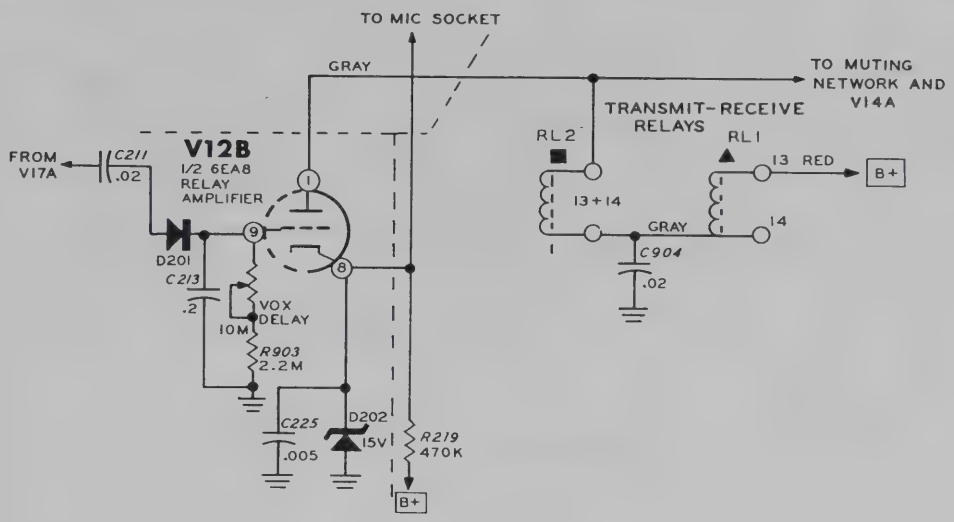


Figure 2-4

Anti-trip Circuit (Figure 2-5)

The anti-trip circuit is used in the receive mode of operation to keep the speaker signals from activating relay amplifier V12B.

An audio signal is coupled through capacitor C305 from audio power amplifier V14B to the Anti-Trip control. This audio signal is then coupled through isolation resistor R25 and rectified by diodes D1 and D2, resulting in a negative DC voltage across capacitor C25 and resistor R16. This negative voltage is then coupled through resistor R27 to the grid circuit of relay amplifier V12B, where it cancels out the positive voltage from the VOX amplifier. Thus, with no positive voltage at its grid, relay amplifier V12B remains cut off, and the relays remain in the receive position.

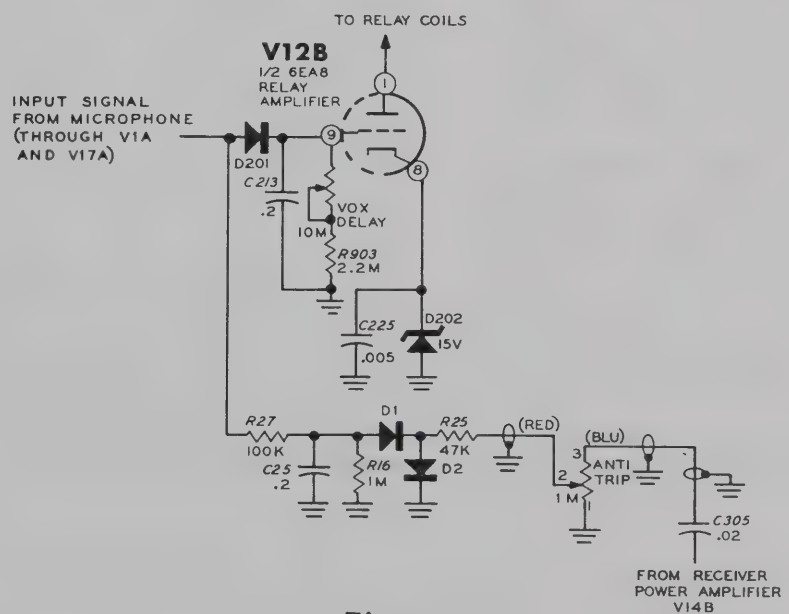


Figure 2-5

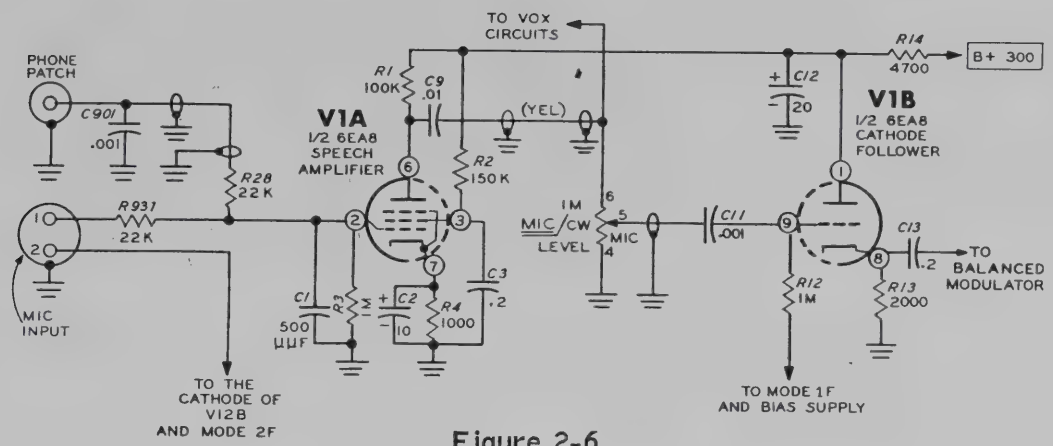


Figure 2-6

Speech Amplifier And Cathode Follower (Figure 2-6)

The audio signal from the microphone is coupled directly from lug 1 of the Microphone input socket to the grid of speech amplifier V1A. Lug 2 of the Microphone input socket is returned to ground through the push-to-talk switch on the microphone. The cathode of relay amplifier V12B is also connected to lug 2 so it will be returned to ground when the push-to-talk switch is depressed, to operate the transmit relays.

Capacitor C1, at the grid of V1A, limits the high frequency response of this stage and passes to ground any RF signals present at this point. The amplified signal from the plate of V1A is coupled through capacitor C9 to the Microphone Level section of the Mic/CW Level control and also to the VOX amplifier circuit.

The setting of the Microphone Level control determines the amount of modulation since it adjusts the amount of speech signal that is coupled through cathode follower V1B to the balanced modulator circuit. For LSB and USB operation, V1B grid resistor R12 is returned to ground through wafer 1F of the Mode switch and contacts 6 and 10 of relay RL2. When the Mode switch is in the Tune or CW position, cathode follower V1B is cut off by a bias voltage that is supplied to it from the junction of bias voltage divider resistors R308 and R309.

Carrier Oscillator (Figure 2-7)

The carrier oscillator consists of two Colpitts crystal oscillators. These oscillators supply an RF signal to the balanced modulator for transmit operation, and a heterodyne signal to product detector stage V13 for receive operation. Tube V16A and crystal Y1 (3396.4 kc) serve as the USB (upper sideband) carrier oscillator, and tube V16B with crystals Y2 (3393.6) and Y3 (3395.4 kc) acts as the LSB (lower sideband) and CW carrier oscillator.

The desired carrier oscillator, V16B for the transmitted frequency being used in this Description (3393.6 kc), is placed in operation by wafer 1R of the Mode switch which connects its plate circuit to B+. Wafer 2R of the Mode switch connects the proper crystal to the grid of V16B: Y2 for LSB operation and Y3 for tune or CW transmit operation.

When the Mode switch is in the CW position, B+ is connected through part of relay RL1 to either V16A or V16B.

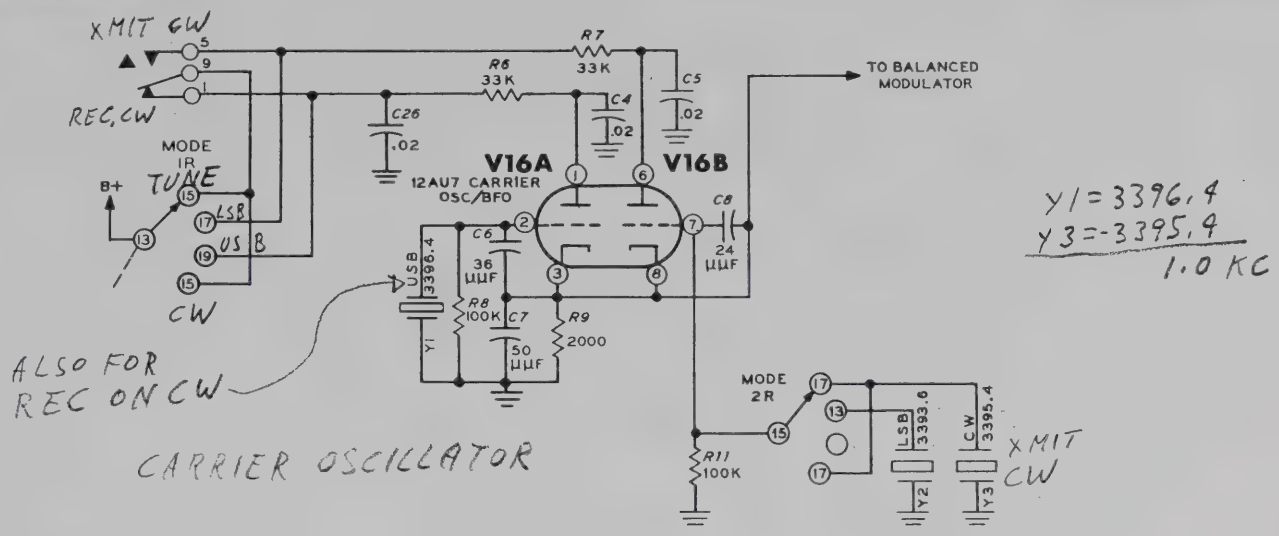


Figure 2-7

For receiving CW signals, lugs 9 and 1 of relay RL1 place tube ~~V16B~~ V16A and crystal ~~Y3~~ Y1 in operation. For transmitting CW, lugs 9 and 5 of relay RL1 place tube V16B and Crystal Y3 in operation.

When receiving CW signals, the receiver is automatically tuned 1 kc below the incoming signal (this signal is zero beat against your transceiving frequency) by V16A and crystal Y1, which are used as a BFO (beat frequency oscillator). When transmitting, tube V16B and crystal Y3 cause the output signal of the Transceiver to be at the same frequency as the incoming signal from the other station.

Balanced Modulator (Figure 2-8)

Diodes CR1, CR2, CR3, and CR4, are connected in a ring type balanced modulator circuit. When the audio signal from cathode follower V1B and the RF signal from carrier oscillator V16 are applied to this balanced modulator, two additional frequencies are produced: one is equal to the sum of the audio and carrier frequencies; and the other is equal to the difference between them. These sum and difference frequencies are the upper and lower sidebands; and only these upper and lower sideband signals appear at the output of the balanced modulator circuit.

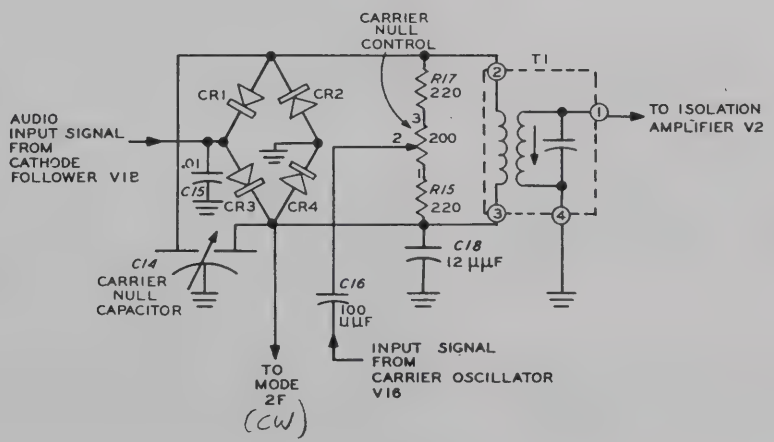


Figure 2-8

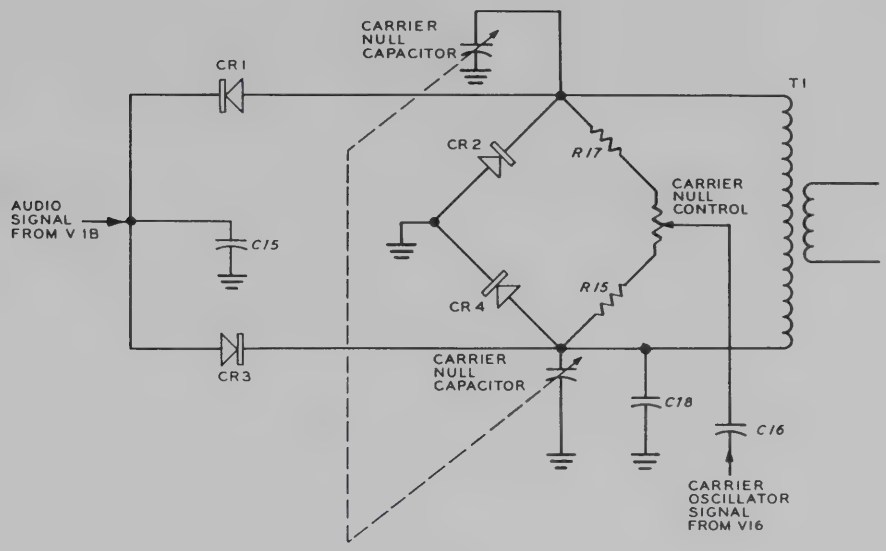


Figure 2-9

The 3393.6 kc carrier oscillator signal is applied through capacitor C16 and across a bridge circuit that consists of the Carrier Null control, resistors R15 and R17, and diodes CR1, CR2, CR3 and CR4 of the modulator diode ring. See Figure 2-9. The carrier signal is balanced out by the Carrier Null control and the Carrier Null capacitor; so there is no output signal from this circuit (until an audio signal is applied).

The audio signal that is coupled to diodes CR1, CR2, CR3, and CR4 from cathode follower V1B unbalances the modulator at an audio rate, causing the sum and difference sideband frequencies to appear at the output of balanced modulator transformer T1. When no audio signal appears at the input, there is no output signal from the balanced modulator circuit. Capacitor C15 is an RF bypass.

When the Mode switch is turned to the CW position, wafer 2F connects one side of the diode ring to ground. This ground connection unbalances the nulled circuit and the unbalance causes an RF output signal to be produced at the secondary of balanced modulator transformer T1. This signal is then coupled through capacitor C22 to isolation amplifier V2. The secondary of transformer T1 is tuned to the CW carrier frequency.

Isolation Amplifier (Figure 2-10)

Both the upper and lower sideband signals from the balanced modulator circuit are coupled through capacitor C22 to the cathode of isolation amplifier V2. V2 isolates the balanced modulator circuit from the crystal filter, and provides proper impedance matching to the crystal filter. The gain of isolation amplifier V2 is varied by the ALC (automatic level control) voltage that is connected to its grid circuit through resistors R21 and R22. The complete ALC circuit will be described later under the heading ALC Circuit.

When transmitting, the output of V2 is coupled through capacitor C506 to the crystal filter. In the CW mode of operation, the gain of V2 is controlled by the CW section of the Mic/CW Level control. This control supplies a variable negative bias to the grid of V2 through wafer 1R of the Mode switch and resistors R22 and R21.

B+ is supplied to the screen of V2 in the transmit mode only, through resistor R937 and contacts 7 and 11 of relay RL2.

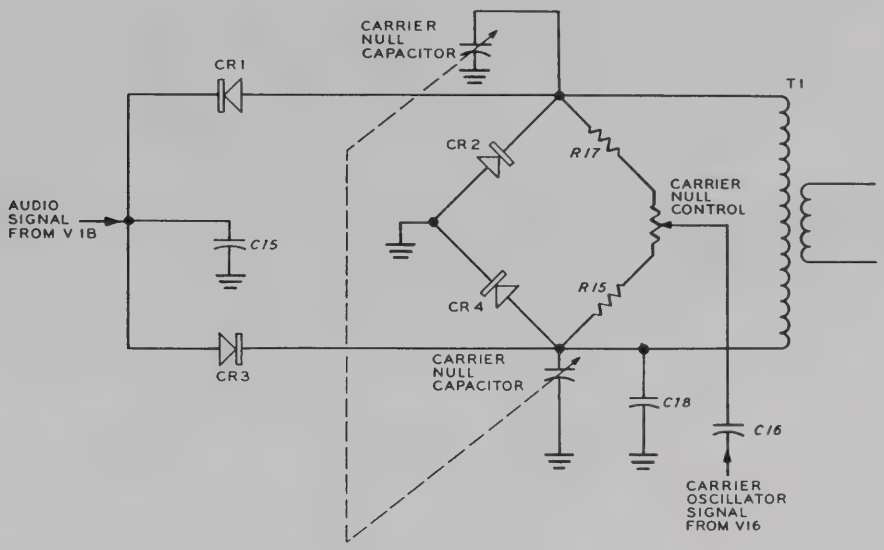


Figure 2-9

The 3393.6 kc carrier oscillator signal is applied through capacitor C16 and across a bridge circuit that consists of the Carrier Null control, resistors R15 and R17, and diodes CR1, CR2, CR3 and CR4 of the modulator diode ring. See Figure 2-9. The carrier signal is balanced out by the Carrier Null control and the Carrier Null capacitor; so there is no output signal from this circuit (until an audio signal is applied).

The audio signal that is coupled to diodes CR1, CR2, CR3, and CR4 from cathode follower V1B unbalances the modulator at an audio rate, causing the sum and difference sideband frequencies to appear at the output of balanced modulator transformer T1. When no audio signal appears at the input, there is no output signal from the balanced modulator circuit. Capacitor C15 is an RF bypass.

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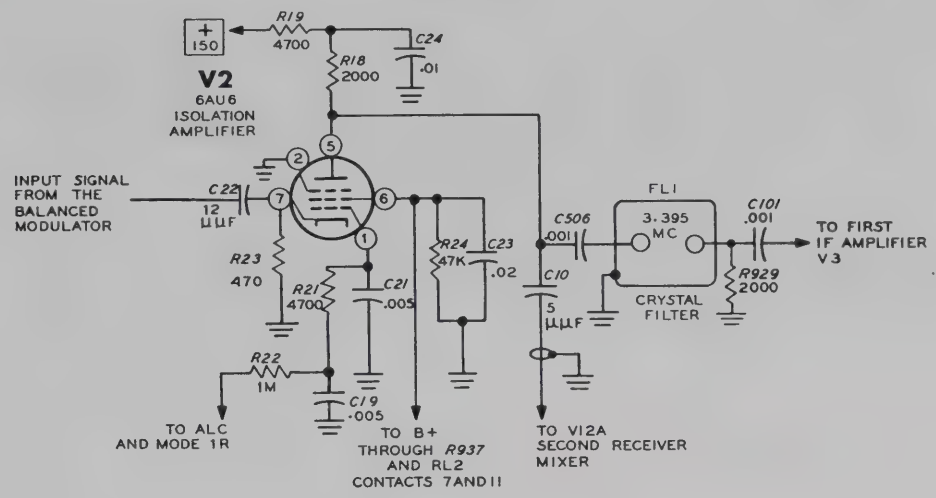


Figure 2-10

Crystal Filter (Figure 2-11)

Crystal filter FL1 has a center frequency of 3395 kc and a usable bandwidth of 2.1 kc (3393.95 kc to 3396.05 kc at the 6 db points). See Figure 2-11. This filter, in the LSB mode of operation, passes only the sum frequencies (the 3393.6 kc carrier frequency plus all the audio frequencies from 350 to 2450 cps), which contain the upper sideband intelligence. The carrier frequency itself, as shown in Figure 2-11, is further reduced 20 db by the crystal filter. This attenuation plus the attenuation of the balanced modulator gives an ultimate carrier attenuation of at least 50 db. (The apparent frequency discrepancy here in sidebands and carrier is overcome later, when the sidebands are inverted in the second mixer.)

In the USB Mode, the filter passes only the difference frequencies (the 3396.5 kc carrier oscillator frequency minus the audio frequencies from 350 to 2450 cps); this contains the lower sideband intelligence. In the CW Mode, a carrier of 3395.4 kc passes through the crystal filter with no attenuation.

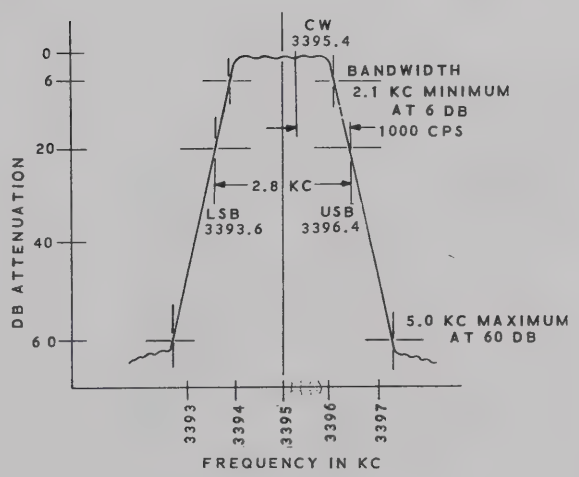


Figure 2-11

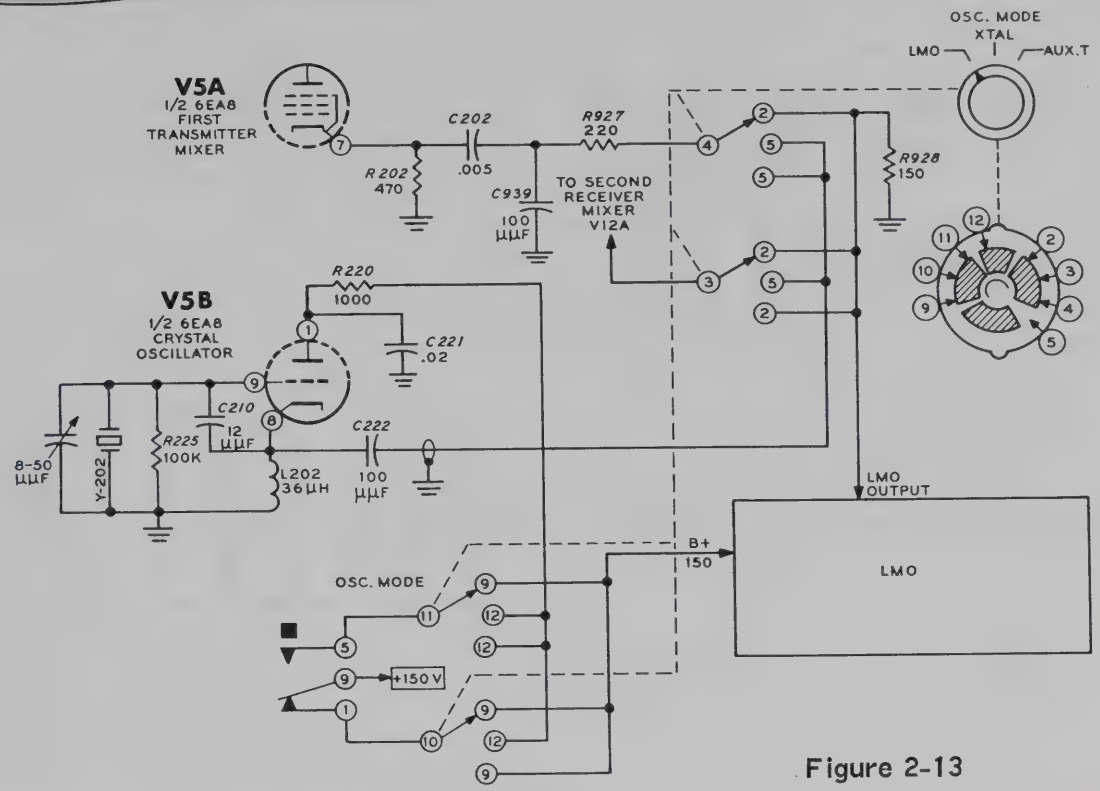


Figure 2-13

V5B is connected to first transmitter mixer V5A, and the LMO output is connected to second receiver mixer V12A.

First Transmitter Mixer (Figure 2-14)

The 3.395 mc IF signal at the grid, and the 5.105 mc LMO signal (or crystal oscillator signal) at the cathode, are mixed in first transmitter mixer tube V5A to produce sum and difference frequencies. The 8.5 mc sum of these two signals is coupled from the plate of V5A through bandpass filter T202 to second transmitter mixer V6.

The Bandpass filter T202 is tuned to pass only those signal frequencies between 8.395 and 8.895 mc; all other frequencies are attenuated. Only the 8.5 mc sum of the IF and LMO signals falls within this frequency range, so it only is passed on to the second mixer.

First transmitter mixer V5A, second transmitter mixer V6, and driver V7 are cut off during the receive mode of operation by a negative voltage that is applied to their grids through diode D301 and resistor R301. This negative voltage is removed for the transmit mode by contacts 6 and 10 of relay RL2, which cause the cathode side of diode D301 to be grounded.

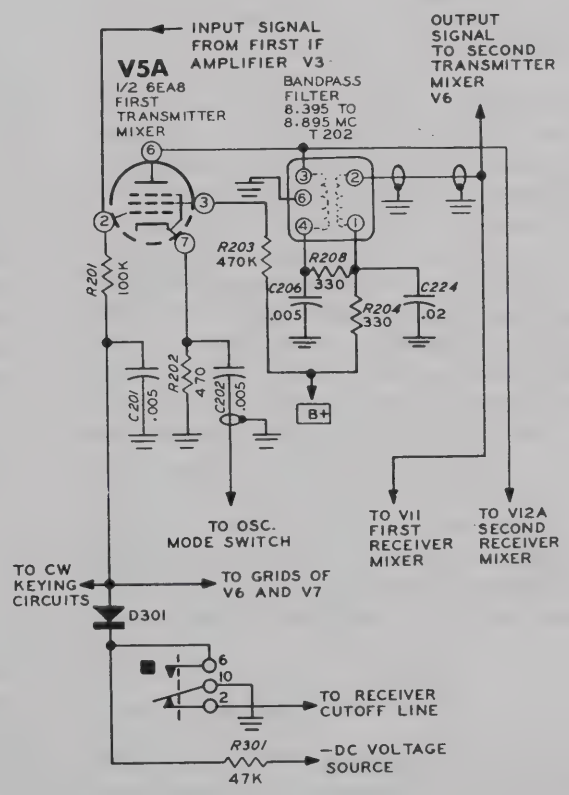


Figure 2-14

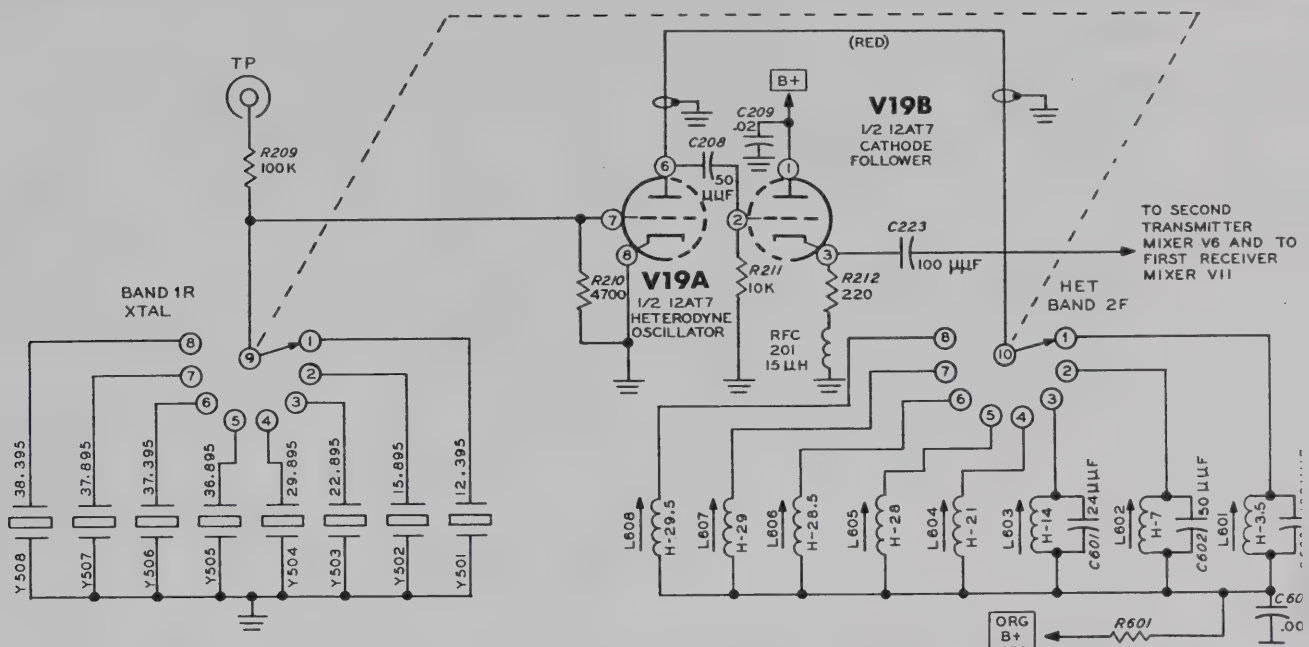


Figure 2-15

Heterodyne Oscillator and Cathode Follower (Figure 2-15)

Heterodyne Oscillator V19A operates as a tuned-plate crystal oscillator. The proper plate coil for each band, L601 through L608, is selected by wafer 2F on the Band switch. The output signal from the plate of the oscillator is coupled through cathode follower V19B to the cathode of second transmitter mixer V6 and to the cathode of first receiver mixer V11. The correct oscillator crystal for each band is selected by wafer 1R of the Band switch. The crystals below 20 mc are fundamental cuts, and the higher frequency crystals operate on their third overtones.

The grid voltage of V19A can be metered at TP to check oscillator activity.

Second Transmitter Mixer (Figure 2-16)

The 8.5 mc signal from the first transmitter mixer and bandpass filter is coupled to the grid of second mixer tube V6. The 12.395 mc output from the heterodyne oscillator is coupled to the cathode of V6. These signals are mixed in V6 to produce the operating frequency.

The frequency of the tuned plate circuit second mixer V6 is the operating frequenc All other frequencies are shorted to groun

In this instance, the difference between the 8 mc input frequency and the 12.395 mc heterodyn oscillator frequency results in a second mixe output frequency of 3.895 mc. This output sign is coupled to the grid of driver stage V

The 3.5 mc plate tuning coil, L701, is connecte across the plate tuned circuit on all bands, alor with the fixed and variable tuning capacitor Band switch wafer 3F connects the corre amount of inductance in parallel with L701 tune each band, except the 3.5 mc (80 mete band, which uses coil L701 only.

Tuning capacitor C421B is connected across tl tuned circuit on all bands. Tuning capacit C421A is connected in parallel with C421B the 80 meter band only, by Band switch waf 3R.

Driver (Figure 2-17)

Driver stage V7 amplifies the 3.895 mc sign from second transmitter mixer V6 to a lev that is sufficient to drive the final amplifier

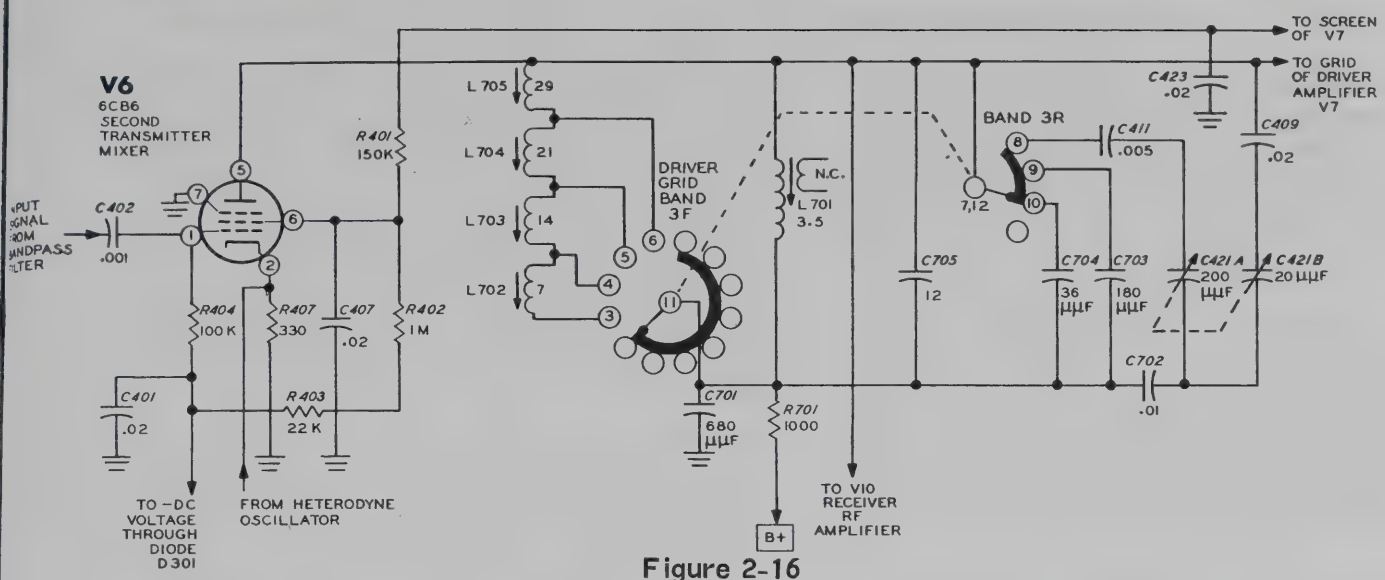


Figure 2-16

The 3.5 mc plate tuning coil, L801, is connected across the plate tuned circuit on all bands along with the fixed and variable tuning capacitors. A secondary (link) winding on L801 is used in the receive mode of operation to couple the received signal into the Transceiver.

Band switch wafer 4F connects the correct amount of inductance in parallel with L801 to tune each band, except the 3.5 mc (80 meter) band, which uses coil L801 only. Band switch wafer 4R connects additional capacitance in parallel with tuning capacitor C422B for the 80 meter (3.5 mc), 40 meter (7 mc), and 20 meter (14 mc) bands.

Neutralization of V7 is accomplished by feeding a portion of the plate signal back to the grid through a "neutralizing wire" capacitor to the plate tuned circuit of the second transmitter mixer.

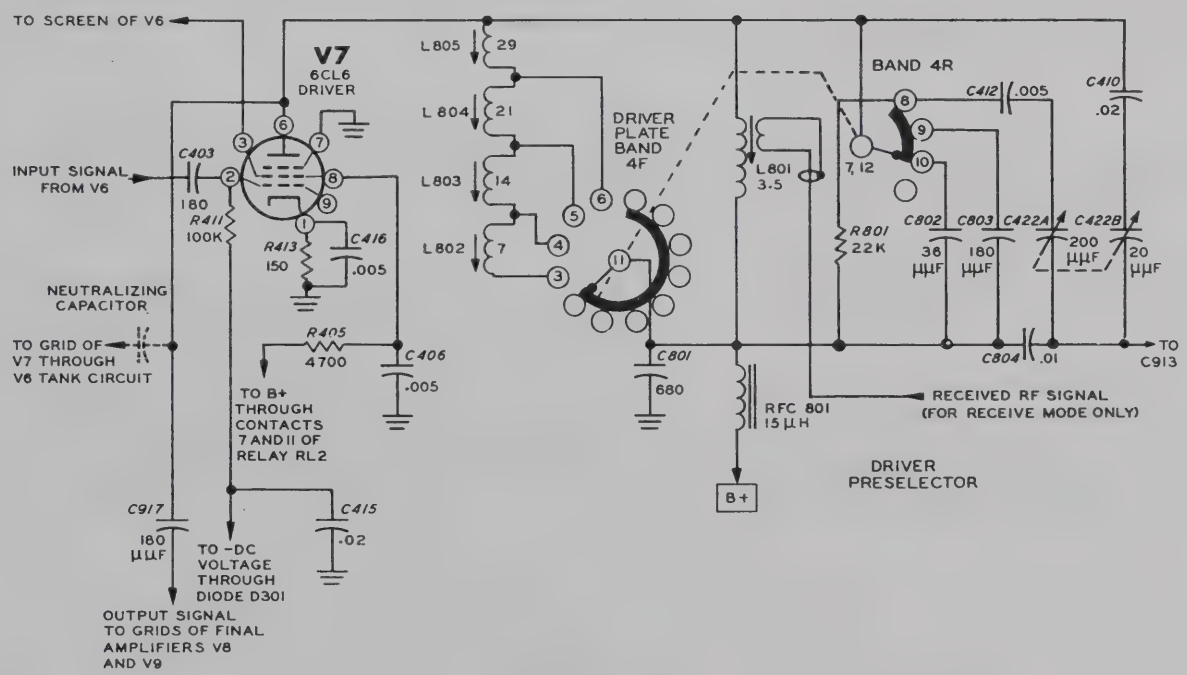


Figure 2-17

Final Amplifiers (Figure 2-18)

Final amplifier tubes V8 and V9 are connected in parallel and function as class AB1 linear amplifiers. A fixed negative bias is applied to the grids of these tubes through resistor R916 and choke L903. This bias limits zero-signal plate current. B+ is removed from the screen grids under receive conditions, by lugs 7 and 11 of relay RL2 to reduce the plate current to zero and cut off the tubes. RF driving voltage is developed across RF choke L903. Plate voltage is shunt fed through RF choke L901.

For the LSB and USB modes of operation, the peak driving voltage is controlled by the Microphone level control (in the grid circuit of V1B) and the limiting action of the ALC (automatic level control) voltage. This ALC voltage is fed back to isolation amplifier V2 and IF amplifier V3.

The output signal from V8 and V9 is coupled through RF parasitic chokes L904 and L902 and through capacitor C915 to the final tuning capacitor C925 and plate tank coils L905 and L906. The parasitic chokes eliminate any tendency toward VHF parasitic oscillation.

Wafer 5R of the Band switch connects the proper portion of the plate tank coil in the circuit for each band by shorting out the unused section. Wafer 5R also selects the proper combination of final tank tuning and loading capacitors for each band.

Neutralization of the final amplifier is accomplished by feeding a portion of the plate signal back to the grid through neutralizing capacitors C913 and C914, and across C801 in a bridge circuit.

The output signal from the final tank coil is coupled through lugs 8 and 12 of relay RL1 to the RF Out socket. The antenna switch allows separate transmit and receive antenna circuits to be used, so the Rec Ant socket can be connected to an external relay for use with linear amplifiers that do not have built-in antenna switching.

ALC Circuit (Figure 2-18)

The ALC (automatic level control) bias voltage is developed from a small portion of the signal in the final amplifier stage. This signal is then rectified, filtered, and fed back to the preceding stages to adjust their gain automatically, as needed. ALC voltage assures maximum transmitter output without overloading.

The ALC voltage for this Transceiver is developed in the Heath TALC™ (Triple Action Level Control) circuit. This circuit keeps the transmitter from overloading, without causing the voice peaks to be flat-topped, by compressing the speech waveform. The triple action of this circuit is described below in paragraphs 1, 2, and 3.

1. Any peak voltages at the grids of final tubes V8 and V9 that drive the grids positive into grid current will develop bursts of voltage across resistor R916. This forms an audio-frequency AC that is coupled through capacitor C921 to voltage doubler rectifiers D902 and D903. The rectified negative output voltage goes to the ALC line.

2. The variations that occur in the final amplifier screen supply voltage on speech peaks produce a varying voltage which is coupled through capacitor C908 to rectifiers D902 and D903. This second voltage source produces additional ALC voltage.

3. The ALC voltage that is obtained from an external linear power amplifier can be applied through the ALC connector to rectifiers D902 and D903. With proper conditions, this source should have predominate control, thus holding down the drive in the Transceiver for best operation.

The rectified voltage from diode D903 is applied to an RC network consisting of resistors R914 and R915, and capacitors C931 and C932. This network filters the DC bias voltage, and allows it to build up quickly and decay slowly.

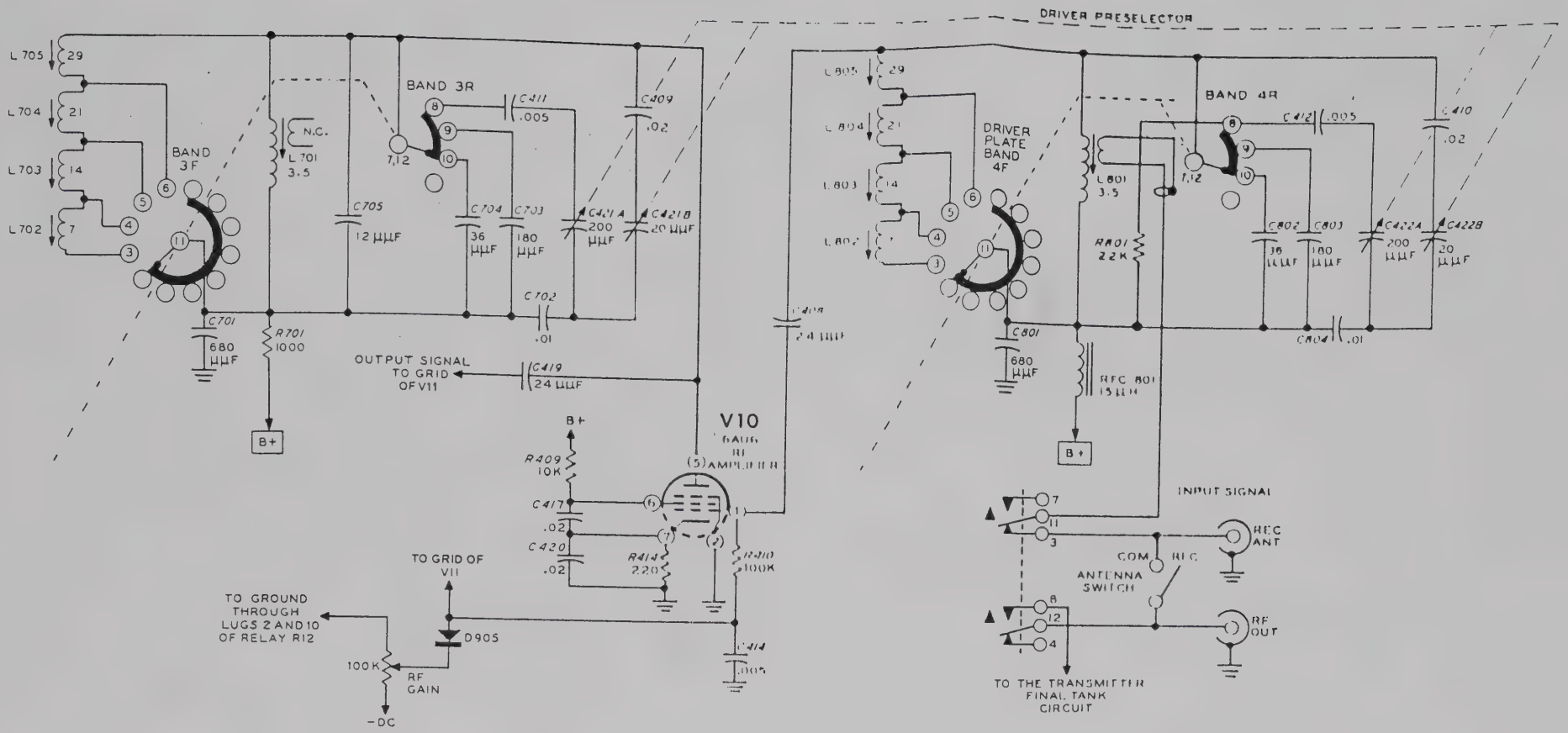
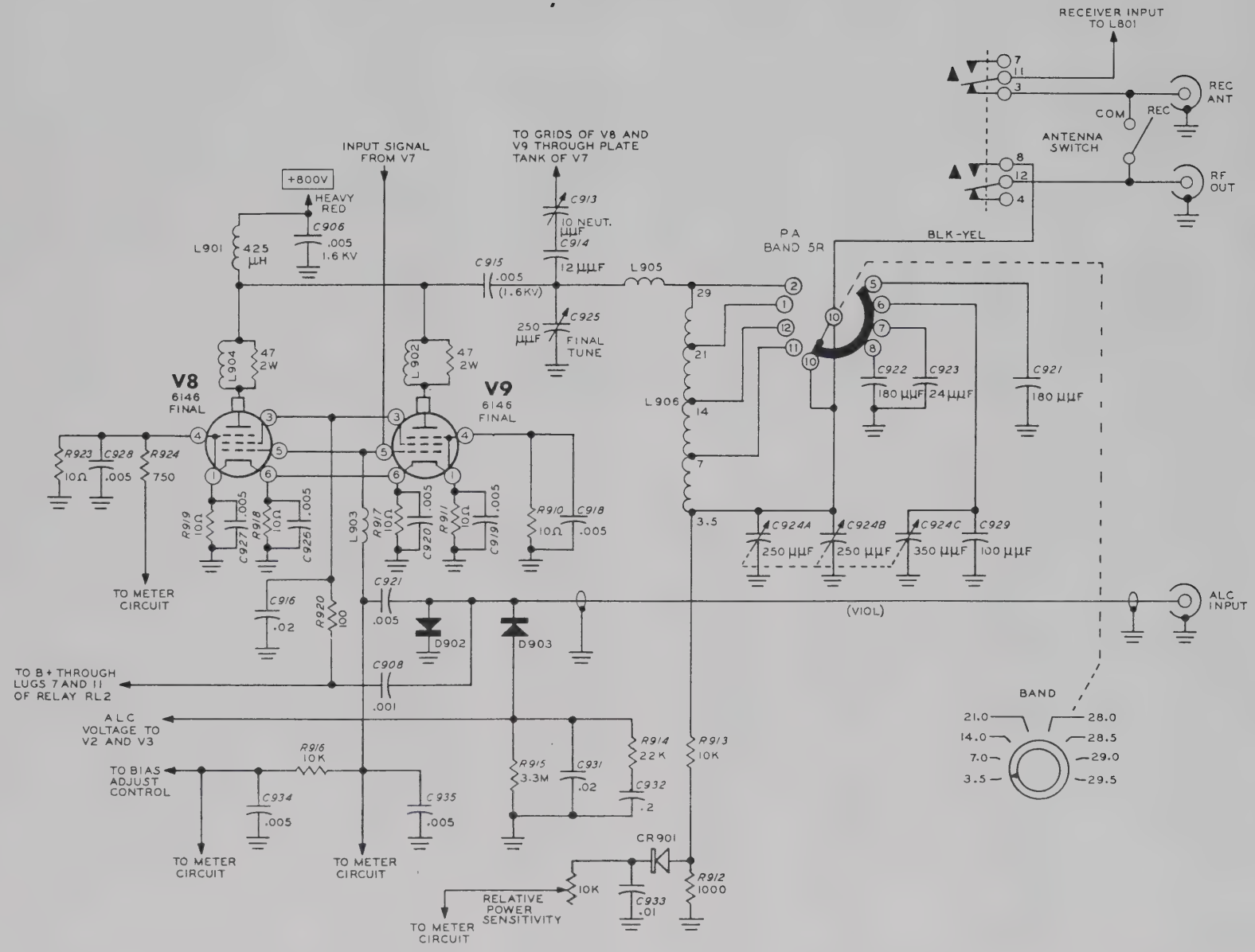

DRIVER PRESELECTOR
L705
29
L704
21
L703
14
L702
7
BAND 3F
N.C.
L701
3.5
BAND 3R
C411
.005
C409
.02
7,12
C705
12 μμF
C704
36 μμF
C703
180 μμF
C421A
200 μμF
C421B
20 μμF
C702
.01
C701
680 μμF
R701
1000
B+
OUTPUT SIGNAL TO GRID OF V11
C419
24 μμF
V10
6AU6
RF AMPLIFIER
R409
10K
C417
.02
C420
.02
R414
220
R410
100K
C418
.005
TO GRID OF V11
D905
100K
RF GAIN
-DC
TO GROUND THROUGH LUGS 2 AND 10 OF RELAY R12
L805
29
L804
21
L803
14
L802
7
DRIVER PLATE BAND 4F
BAND 4R
C412
.005
C410
.02
L801
3.5
7,12
R801
22K
C802
36 μμF
C803
180 μμF
C422A
200 μμF
C422B
20 μμF
C804
.01
C801
680 μμF
RFC 801
15 μH
INPUT SIGNAL
REC ANT
COM
REC
ANTENNA SWITCH
RF OUT
TO THE TRANSMITTER FINAL TANK CIRCUIT

FIGURE 2-22


RECEIVER INPUT TO L801
REC ANT
COM
REC
ANTENNA SWITCH
RF OUT
PA BAND 5R
BLK-YEL
INPUT SIGNAL FROM V7
TO GRIDS OF V8 AND V9 THROUGH PLATE TANK OF V7
+800V
HEAVY RED
C906 .005 1.6 KV
L901 425 µH
C913 10 NEUT. µµF
C914 12 µµF
C915 .005 (1.6KV)
L905
C925 250 µµF FINAL TUNE
L904 47 2W
L902 47 2W
V8 6146 FINAL
V9 6146 FINAL
L906
C922 180 µµF
C923 24 µµF
C921 180 µµF
R923 10Ω
C928 .005
R924 750
C924A 250 µµF
C924B 250 µµF
C924C 350 µµF
C929 100 µµF
R919 10Ω
C927 .005
R918 10Ω
C926 .005
L903
R917 10Ω
C920 .005
R911 10Ω
C919 .005
R910 10Ω
C918 .005
TO METER CIRCUIT
C916 .02
R920 100
C921 .005
D902
D903
(VIOL)
ALC INPUT
TO B+ THROUGH LUGS 7 AND 11 OF RELAY RL2
C908 .001
ALC VOLTAGE TO V2 AND V3
R916 10K
TO BIAS ADJUST CONTROL
C934 .005
C935 .005
R915 3.3M
C931 .02
R914 22K
C932 .2
R913 10K
BAND
21.0
14.0
7.0
3.5
28.0
28.5
29.0
29.5
CR901
R912 1000
10K
C933 .01
RELATIVE POWER SENSITIVITY
TO METER CIRCUIT
TO METER CIRCUIT
TO METER CIRCUIT

CW Operation

When the Mode switch is turned to the CW position, the following circuit changes occur:

1. Cathode follower V1B is cut off and the arm of VOX Sensitivity control is grounded so stray microphone signals do not reach the balanced modulator or VOX circuits.

2. CW crystal Y3 is connected to the grid of carrier oscillator V16B.

3. The balanced modulator circuit is unbalanced so it will produce an output signal (see Mode switch wafer 2F).

4. The drive to the final amplifiers is controlled by the CW section of the MIC/CW Level control, which adjusts the bias of isolation amplifier V2 and IF amplifier V3.

5. Cut off bias is applied to the grids of transmitter mixers V5A and V6, and to the grid of driver amplifier V7, through Mode switch wafer 1F and diode D904.

6. Tone oscillator V15A is turned on.

When the key is closed, the 1000 cps tone signal is coupled to the VOX circuit, where it causes the relays to be switched to the transmit position. The relays stay in this position for a length of time that is determined by the setting of the VOX Delay control.

At the same time, the key shorts out the cut-off bias that is applied to the transmitter mixer stages and to the driver amplifier stage, allowing them to conduct and place the transmitter on the air.

The RF output signal from CW carrier oscillator V16B is coupled to the balanced modulator stage. The unbalanced condition of this stage causes the RF signal to be coupled through transformer T1 to isolation amplifier V2. From V2, the signal proceeds through the transmitter in the same manner as the LSB and USB signals.

Switching (Figure 2-20)

Figure 2-20 shows the position and assigns an identifying number to each of the relay sections on the main schematic. The numbers will be used in the following paragraphs to explain how each section is used.

1. This section applies B+ voltage to the correct half of carrier oscillator tube V16 in the Tune and CW positions of the Mode switch.

2. This section is connected to the power plug for external use with linear amplifiers and other devices. The contacts have a rating of 3 amperes at 117 VAC or 30 V DC.

3. These contacts apply B+ voltage to the screens of V2, V7, V8, and V9 in the transmit mode, and to the screen of V4, V10 and V11 in the receive mode of operation.

4. These contacts ground out the receiver cut-off bias in the receive mode. In the transmit mode they ground out the cut-off bias that is applied through diode D301 to transmitter stages V5A, V6, and V7.

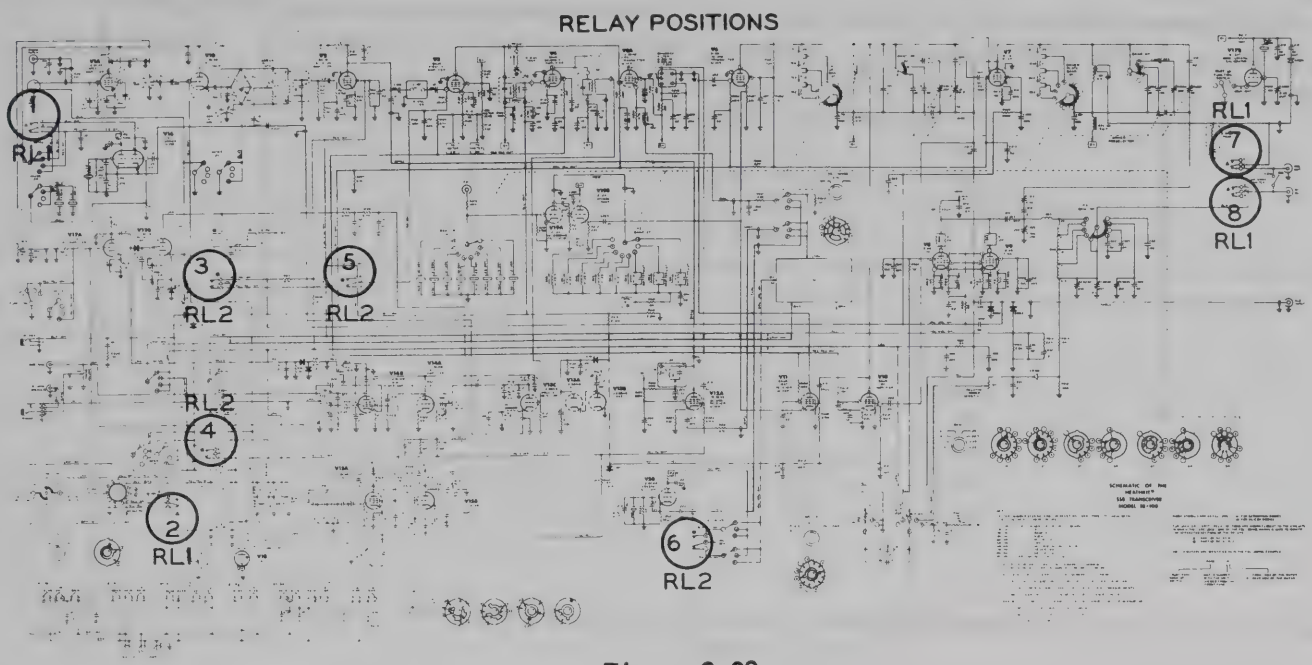


Figure 2-20

5. In the transmit mode, these contacts apply ALC voltage (or CW bias) to the grid of V3. In the receive mode they apply AVC voltage to V3.

6. This section applies +150 V B+ voltage through the Oscillator Mode switch to either the LMO or crystal oscillator V5B.

7,8. These contacts switch the antenna between the receive and transmit circuits.

When the Transceiver is in the transmit mode, a large negative bias (approximately -90 volts) is applied through the RF Gain control and diode D905 to the grids of RF amplifier V10, and first receiver mixer V11. Smaller amounts of negative bias are also applied to second receiver mixer V12A, second IF amplifier V4, and audio amplifier V14A. The large bias is necessary at V10 to keep the transmitter signal at the driver plate from causing V10 to conduct on large voltage peaks. (If this happens, spikes will appear at the peaks of the envelope on the transmitted signal.)

First audio amplifier V14B is cut off by the bias voltage to quiet the receiver audio stages when LSB or USB signals are being transmitted. A negative pulse is also applied to the grid of V14B to cut it off before the relay contacts close. This is done so the switching transients, which cause a "popping" sound, will not be heard in the speaker.

The negative pulse that is applied to V14B is formed by the sudden voltage change that occurs at the plate of relay amplifier V12B when that stage is turned on by the VOX circuit. This pulse is shaped by a network that consists of resistors R337, R338, R339, and R340 and capacitors C320, C321, C322, and C323.

BAND	RECEIVED SIGNAL FREQUENCY	HETERODYNE OSCILLATOR FREQUENCY (CRYSTAL)	SIGNAL FREQUENCY AT BANDPASS FILTER (BETWEEN 8.395 AND 8.895)	2ND RECEIVER MIXER, CRYSTAL FILTER AND IF FREQUENCIES	LMO FREQUENCY (BETWEEN 5 AND 5.5)
3.5 to 4	3.895	12.395	8.5	3.395	5.105
7 to 7.5	7.2	15.895	8.695	3.395	5.3
14 to 14.5	14.2	22.895	8.695	3.395	5.3
21 to 21.5	21.3	29.895	8.595	3.395	5.2
28 to 28.5	28.1	36.895	8.795	3.395	5.4
28.5 to 29	28.7	37.395	8.695	3.395	5.3
29 to 29.5	29.2	37.895	8.695	3.395	5.3
29.5 to 30	29.6	38.395	8.795	3.395	5.4
All frequencies in mc.					

Figure 2-21

RECEIVER CIRCUITS

NOTE: Figure 2-21 shows the various frequencies that will be found throughout the Transceiver on the different bands. A received signal (lower sideband) frequency of 3.895 mc, shown on the first line of the chart, will be used when tracing through the receiver circuits. The other associated frequencies used in this Description are also shown on the first line.

RF Amplifier (Figure 2-22, fold-out from Page 136)

The 3.895 mc input signal from the antenna is coupled through lugs 3 and 11 of the antenna relay (RL1) to the link winding of coil L801. The secondary of L801, part of the Driver Preselector capacitor, and the other components in the driver plate tank circuit, are also used as the input tuned circuit for RF amplifier V10. From L801, the signal is coupled through capacitor C408 to the grid of V10.

The received signal is amplified in V10, and then coupled through capacitor C419 to first receiver mixer V11. The plate tuned circuit of V10 consists of coil L701, part of the Driver Preselector capacitor, and the other components of the second transmitter mixer plate tank circuit.

The gain of RF amplifier V10 and first receiver mixer V11 are controlled by the AVC voltage, and an adjustable negative bias that is coupled to their grids from the RF Gain control.

First and Second Receiver Mixers (Figure 2-23)

The amplified 3.895 mc signal from RF amplifier V10 is coupled through capacitor C419 to the grid of V11, the first receiver mixer. At the same time, a crystal controlled 12.395 mc signal is coupled to the cathode of V11 from V19B, the heterodyne oscillator cathode follower. These two signals are then mixed together in V11 and coupled with the sum and difference frequencies to the bandpass filter.

The bandpass filter, which passes only the frequencies between 8.395 and 8.895 mc, allows the 8.5 mc difference frequency to pass on from V11 to the grid of second mixer tube V12A.

A 5.105 mc signal is coupled from either the LMO or crystal oscillator V5B, through the Oscillator Mode switch, to the cathode of V12A. The 8.5 mc signal at the grid and the 5.105 mc signal at the cathode are then mixed together in tube V12A and the 3.395 mc difference frequency is coupled through crystal filter FL1 to the IF amplifiers.

Crystal filter FL1 sets the IF bandwidth at just 2.1 kc wide (see Figure 2-11). This narrow, steep-sided passband permits good selectivity to be realized in crowded amateur bands.

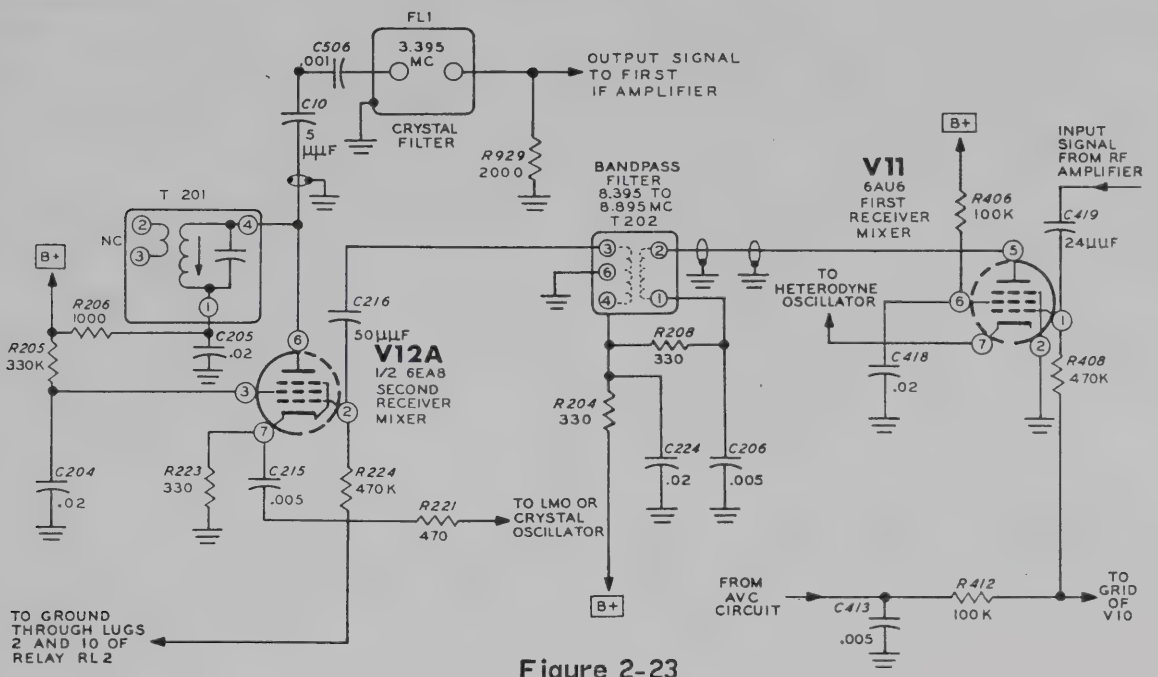


Figure 2-23

IF Amplifiers (Figure 2-24)

The signal from crystal filter FL1 is coupled through capacitor C101 to first IF amplifier V3. The amplified signal from V3 is coupled to two places: to the grid of V5A, which is cut off in receive operation; and to second IF amplifier V4 through IF transformer T102.

The amplified signal from V4 is coupled through IF transformer T103 to the product detector, V13C. The same signal is also coupled through capacitor C112 to the plate of AVC rectifier V13B. Supply voltage for the screen of IF amplifier V4 is switched through lugs 3 and 11 of relay RL2.

AVC voltage is supplied to the grid of V4 by the AVC line. AVC voltage is switched to the grid of V3 through lugs 4 and 12 of relay RL2.

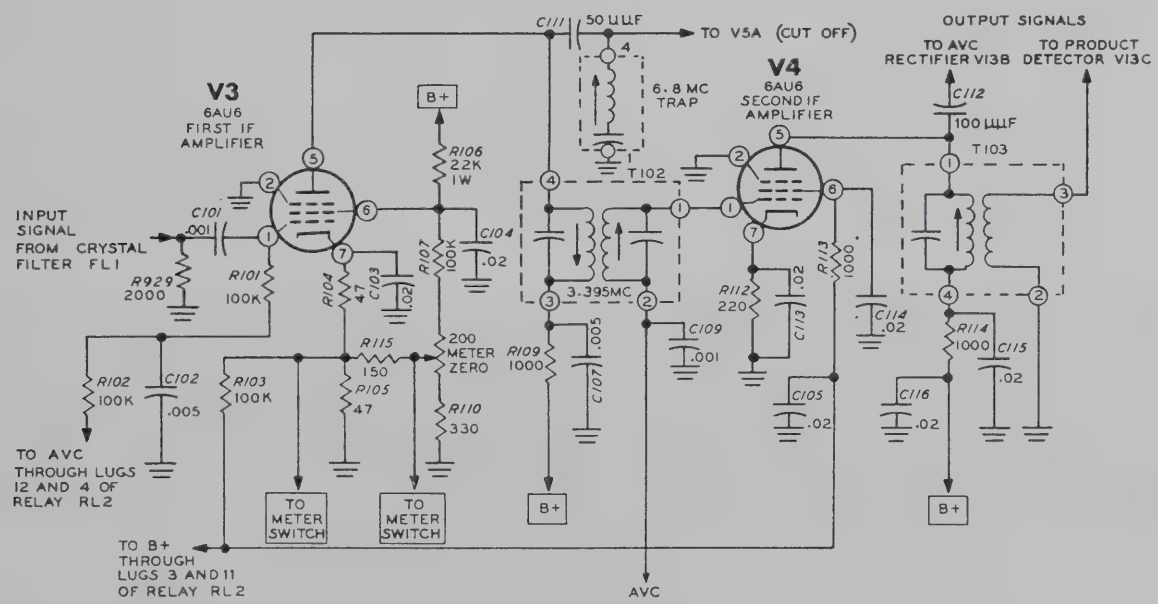


Figure 2-24

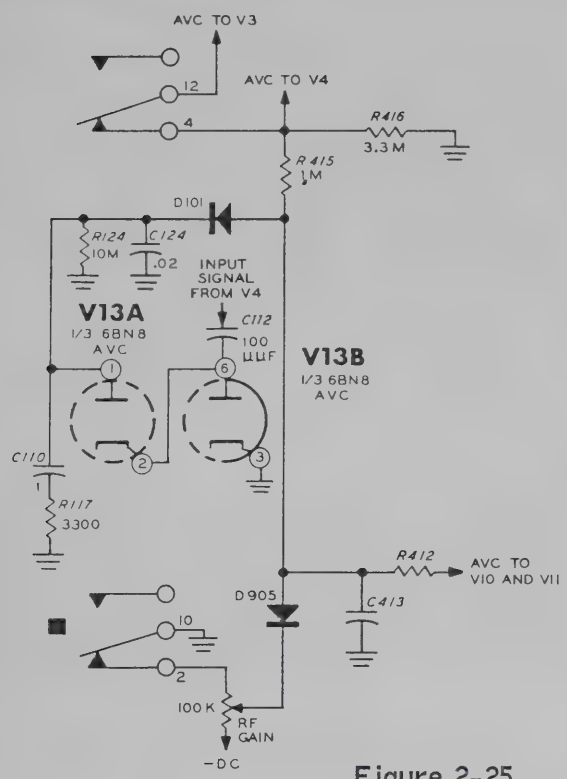


Figure 2-25

AVC Circuit (Figure 2-25)

The negative bias at the control grids determines the amount of amplification that will be obtained from RF amplifier V10, first receiver mixer V11, and IF amplifiers V3 and V4. The DC bias for these stages comes from the following two sources: from the -DC voltage at the arm of the RF Gain control; and from the AVC voltage. These two voltage sources are connected to diodes D101 and D905, which act as a diode gate. This diode gate permits either voltage to control the gain (of V10, V11, etc.) without interacting with each other.

From this point, the bias voltage is coupled through resistor R412 to the grids of V10 and V11, and through resistor R415 to the grids of V3 and V4. Voltage divider resistors R415 and R416 cause only one half of the total bias voltage to be coupled to the grids of IF amplifiers V3 and V4.

AVC voltage is obtained by coupling part of the IF signal through capacitor C112 to AVC diodes V13A and V13B. These diodes produce a negative DC voltage at pin 1 of V13A that is proportional to the signal strength. This negative voltage is developed across resistors R124 and R117, and capacitors C110 and C124. Capacitor C124 charges quickly to the peak voltage so the AVC will respond quickly to keep large signals from being distorted in V3, V4, V10, and V11. Capacitor C110 charges more slowly, and causes the AVC voltage to be proportional to the average signal level of the received signal. This produces a fast-attack, slow-release AVC characteristic.

An incoming signal that produces a negative AVC voltage that is significantly higher than the bias voltage from the RF Gain control causes the gain of V10, V11, V3, and V4 to be reduced. This keeps the output of the RF and IF amplifier stages at a nearly constant level despite wide amplitude changes in the received signal.

Product Detector (Figure 2-26)

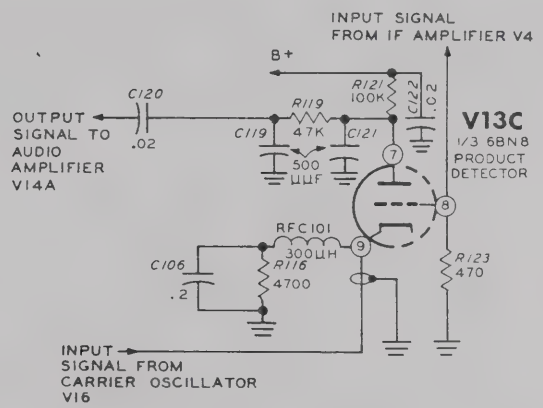


Figure 2-26

The 3.395 mc signal from IF amplifier V4 is coupled to the grid of product detector tube V13C. At the same time, the signal from carrier oscillator V16 is fed to the cathode of V13C (3.3936 mc for the lower sideband, or 3.3964 mc for the upper sideband). These two signals are then mixed together in V13C, resulting in an audio output signal which is the

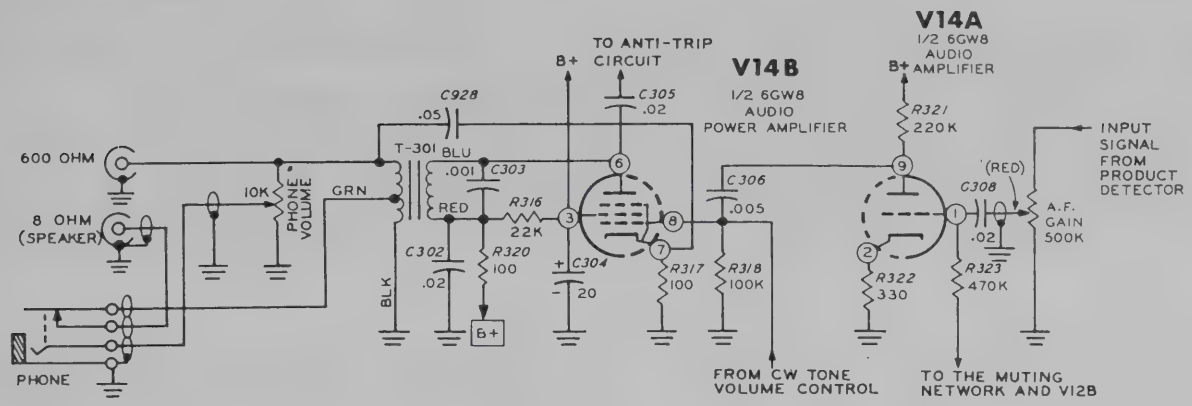


Figure 2-27

difference frequency between these two signals. Capacitors C119 and C121, and resistor R119 are connected in a filter network that bypasses any RF signal coming from V13C to ground, but permits the audio signal to pass through to audio amplifier V14A.

Audio And Power Amplifier (Figure 2-27)

The signal from the product detector is applied to the AF Gain control to determine the amount of signal that will be coupled through capacitor C308 to the grid of audio amplifier V14A. The audio signal is amplified in V14A and then coupled to power amplifier V14B. Tube V14B amplifies the signal further and supplies the audio power through output transformer T301 to the output connectors. Capacitor C928 couples a portion of the output back to the cathode of V14B as negative feedback for less distortion.

Three outputs are provided by the secondary of transformer T301: a headphone output, a 600 Ω output, and an 8 Ω speaker output. Audio power to the 8 Ω speaker jack is rated at 2 watts maximum.

An audio signal is also supplied to the anti-trip network from the plate of V14B.

CRYSTAL CALIBRATOR (Figure 2-28)

Crystal calibrator stage V17B is connected as a Pierce crystal oscillator. When the Function switch is placed in the Calibrate position, the cathode of V17B is grounded, and an accurate 100 kc signal is connected through capacitor C218 and diode CR201 to the antenna input of the receiver. The harmonics of this signal are then used for dial calibration checks.

Calibrate Crystal capacitor C220 may be adjusted to set the crystal calibrator to exactly 100 kc using some standard such as WWV.

The Calibrate position of the Function switch also connects the grid of VOX amplifier V17A to ground to avoid accidental energizing of the transmitter when using the crystal calibrator.

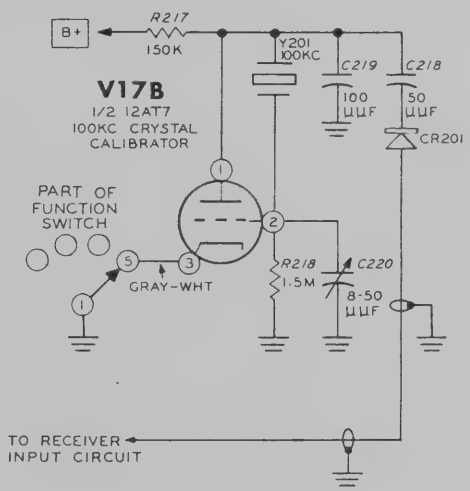


Figure 2-28

METERING CIRCUITS (Figure 2-29)

For the transmitting mode of operation, there are five different settings of the Meter switch: final Grid current, final Plate current, ALC voltage, Relative Power output, and High Voltage. In the ALC position, in the receive mode, the meter operates as an S-Meter.

To measure the grid current for final amplifiers V8 and V9, the meter is shunted across resistor R916 in the grid circuit of these tubes. The meter will then read from 0 to 1 ma of grid current.

To measure final amplifier plate current, the meter is connected between the cathodes of the finals and ground, in parallel with the cathode resistors. Plate current can then be read on the 0 to 500 ma range of the meter.

To measure ALC voltage, the meter is connected between the cathode and screen circuits of IF amplifier V3. The meter zero control is adjusted for zero current flow through the meter with no signal input. When V3 receives a signal, the resulting current fluctuations in the cathode are indicated on the meter. Since the ALC voltage at the grid controls the gain of V3, the cathode current of V3 gives a relative indication of the ALC voltage level.

For Relative Power measurements, a small portion of the transmitter output signal is developed across resistor R912, rectified by diode CR901, and filtered by capacitor C933. The resulting DC voltage, is then indicated by the meter. The Relative Power Sensitivity control allows the operator to set his full power output indication at a convenient meter reading.

The high voltage is brought down to a measureable level by a precision multiplier resistor, R921. 0-1000 volts can be read on the 0-10 scale of the meter. Resistor R922 keeps the open circuit voltage at a safe level when the Meter switch is in other positions.

When the Transceiver is in the receive condition, and the Meter switch is at ALC, the meter indicates the relative strength of the received signal in S-units. The circuit operates just as it does when it measures ALC voltage, except that the current in V3 is now controlled by the AVC voltage at the grid of V3.

The Meter Zero control is adjusted for a zero indication on the meter with the antenna disconnected and RF Gain control at the full clockwise position. The decrease in plate current (due to a larger AVC voltage) that occurs when a signal is received by tube V3 then appears as indications on the S-Meter.

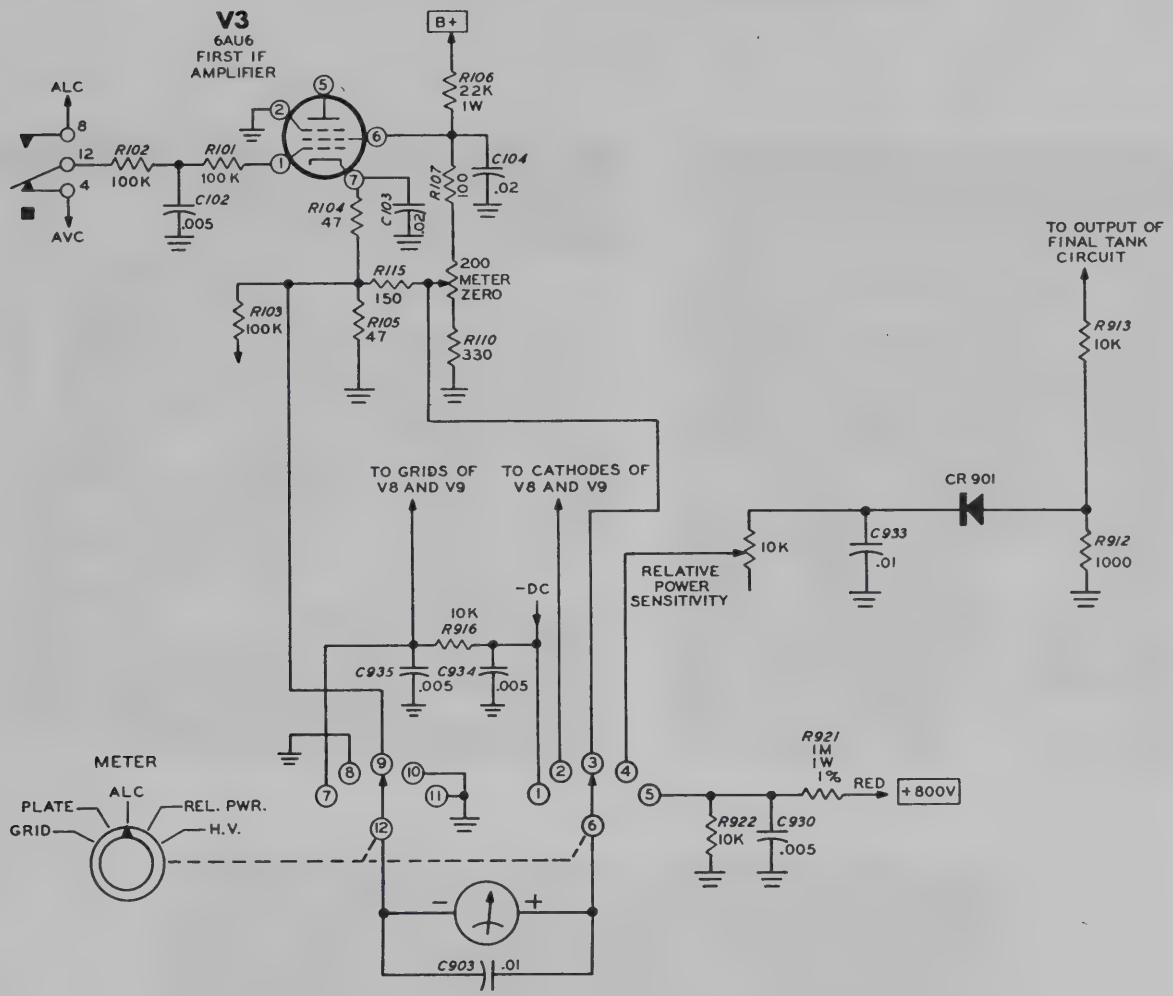
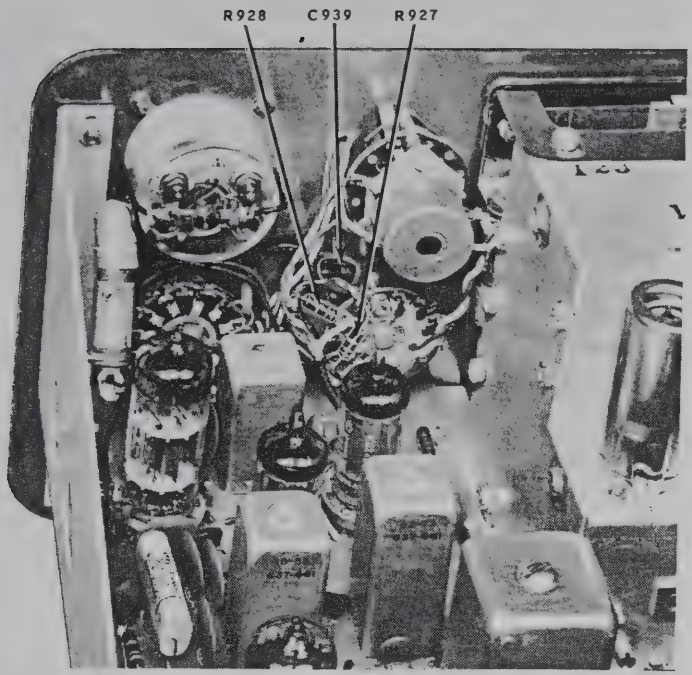
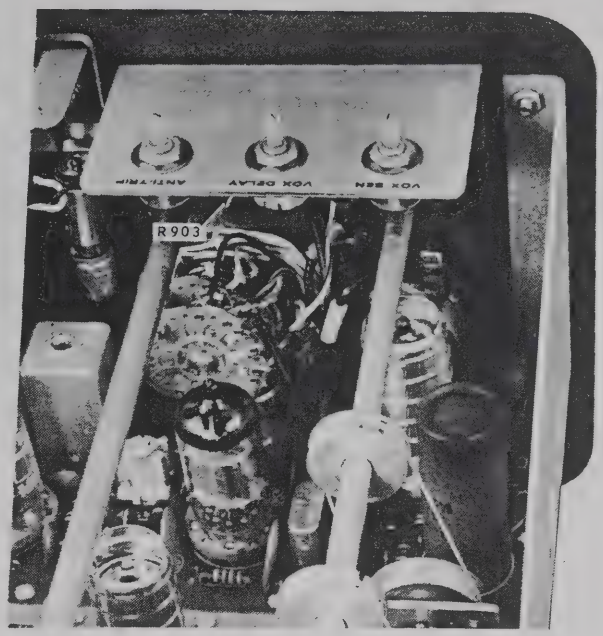
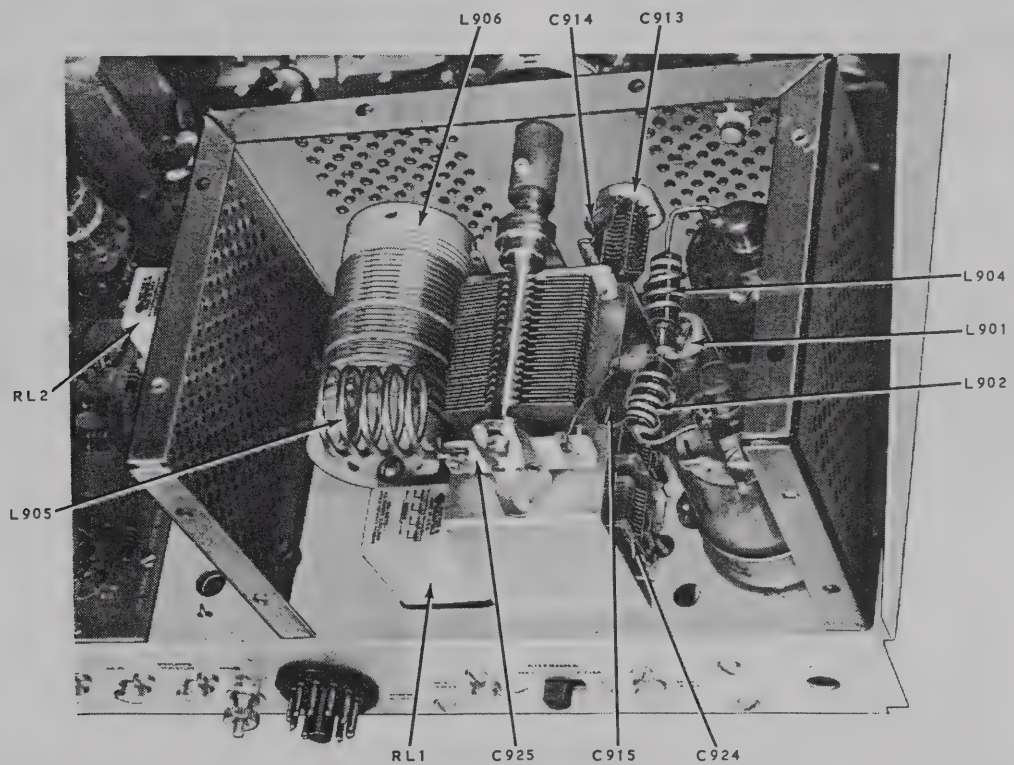

V3
6AU6
FIRST IF
AMPLIFIER
B+
R106
22K
1W
ALC
AVC
R102
100K
R101
100K
C102
.005
R104
47
C103
.02
R107
100
C104
.02
R115
150
200
METER
ZERO
R103
100K
R105
47
R110
330
TO OUTPUT OF
FINAL TANK
CIRCUIT
R913
10K
TO GRIDS OF
V8 AND V9
TO CATHODES OF
V8 AND V9
CR 901
10K
C933
.01
R912
1000
RELATIVE
POWER
SENSITIVITY
-DC
10K
R916
C935
.005
C934
.005
METER
ALC
PLATE
GRID
REL. PWR.
H.V.
R921
1M
1W
1%
RED
+800V
R922
10K
C930
.005
C903
.01

Figure 2-29

CHASSIS PHOTOGRAPHS

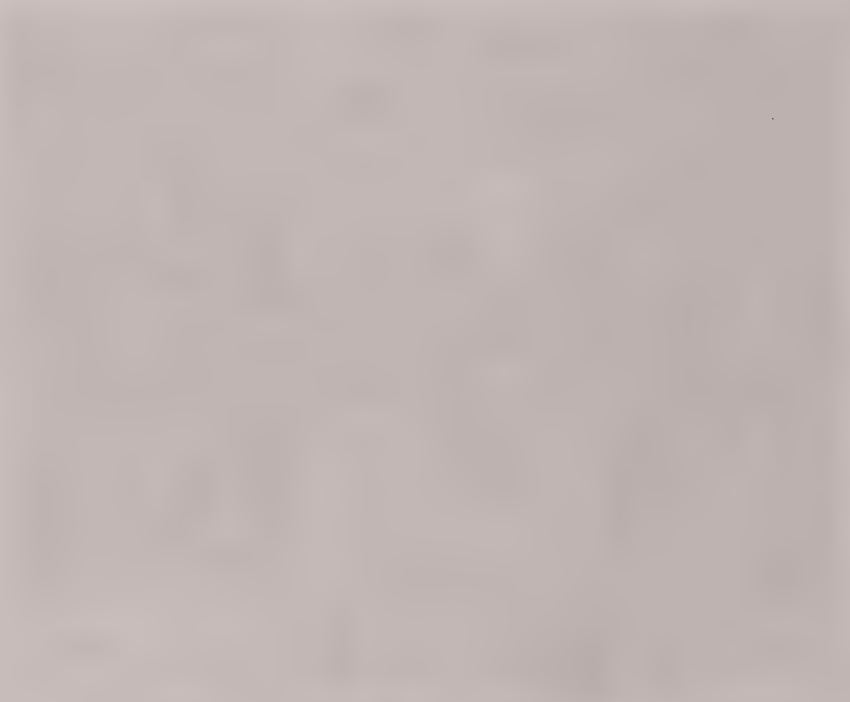


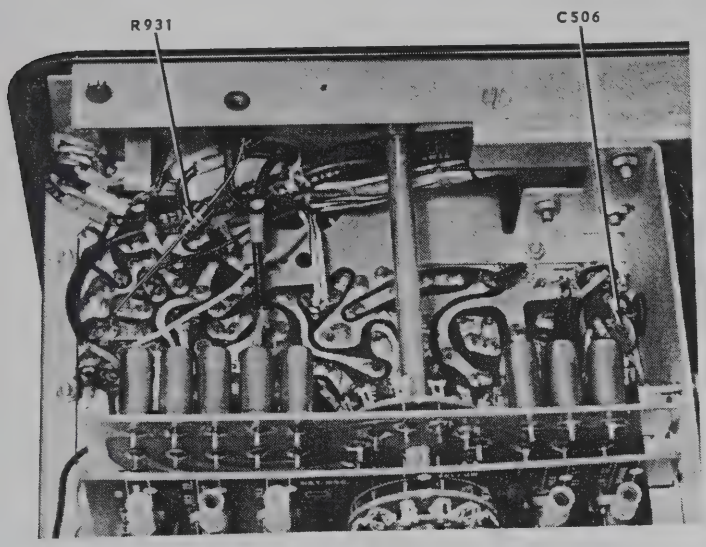


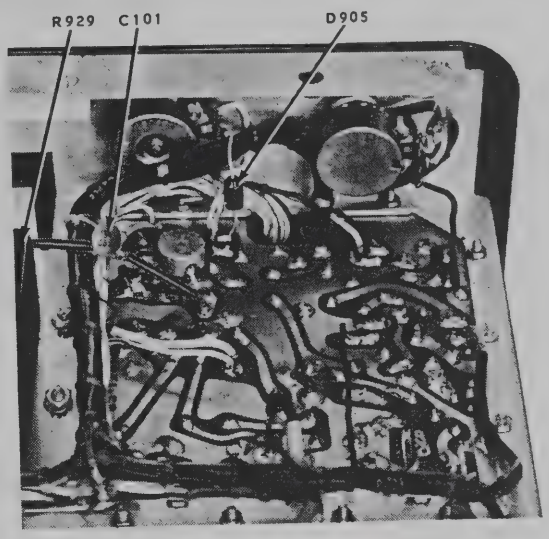


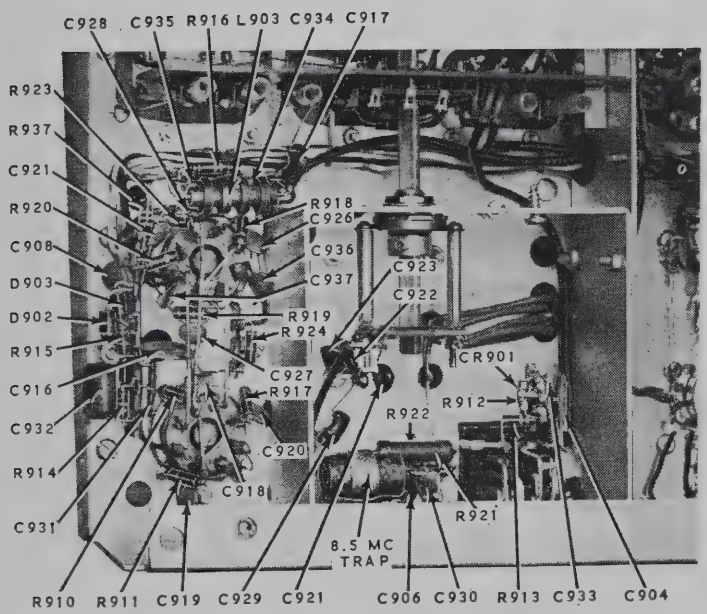
TOP VIEW

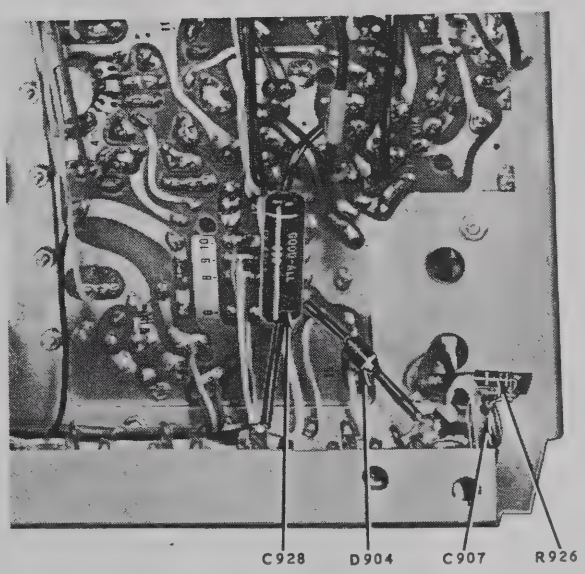





R931
C506


R929
C101
D905

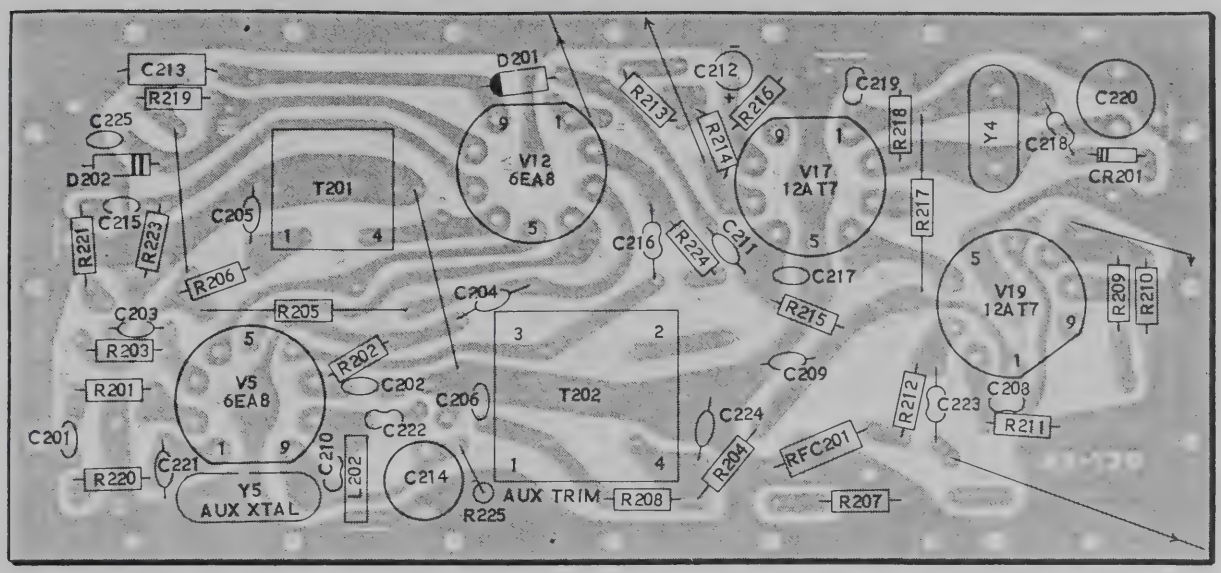

C928
C935
R916
L903
C934
C917
R923
R937
C921
R920
C908
D903
D902
R915
C916
C932
R914
C931
R918
C926
C936
C937
C923
C922
R919
R924
C927
R917
C920
C918
CR901
R912
R922
R921
8.5 MC
TRAP
R910
R911
C919
C929
C921
C906
C930
R913
C933
C904


C928
D904
C907
R926

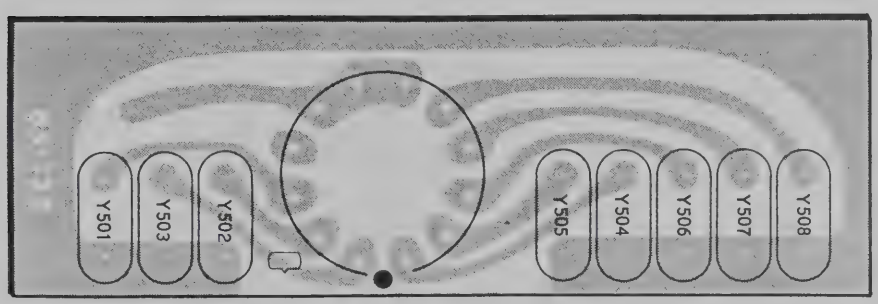
BOTTOM VIEW

CIRCUIT BOARD X-RAY VIEWS

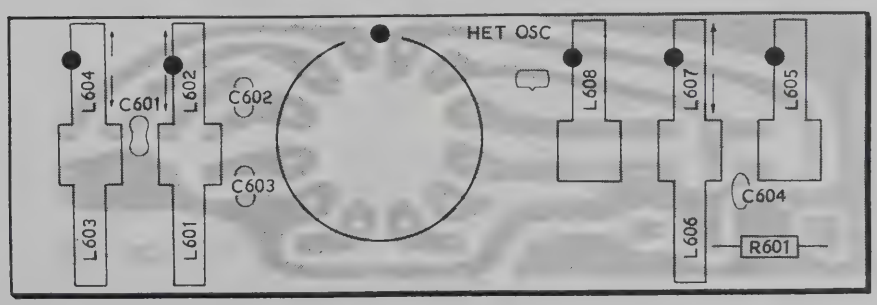
(VIEWED FROM FOIL SIDE)



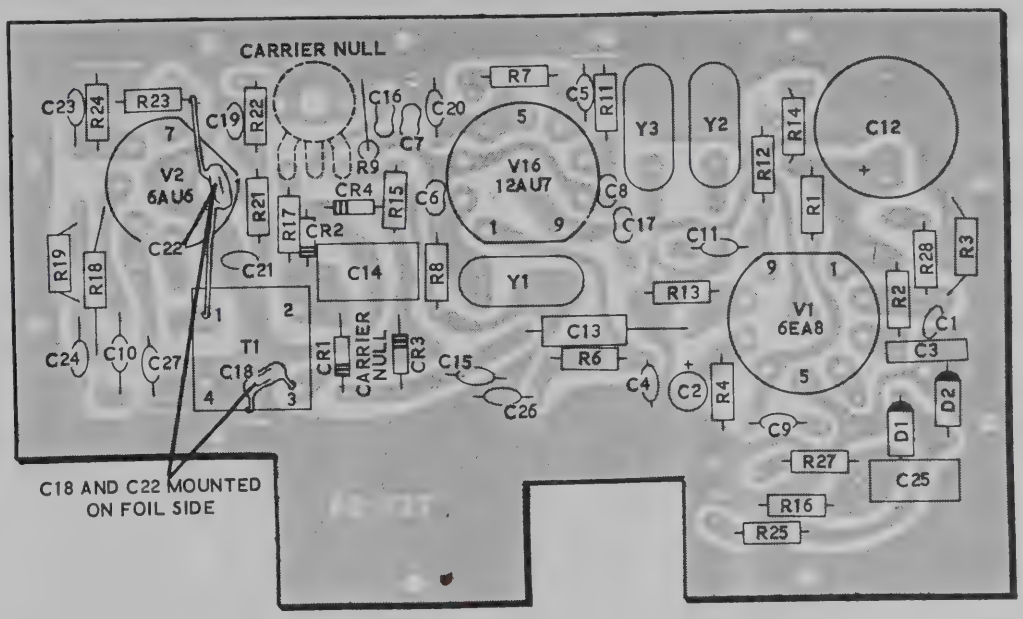
BANDPASS CIRCUIT BOARD
#85-129P223



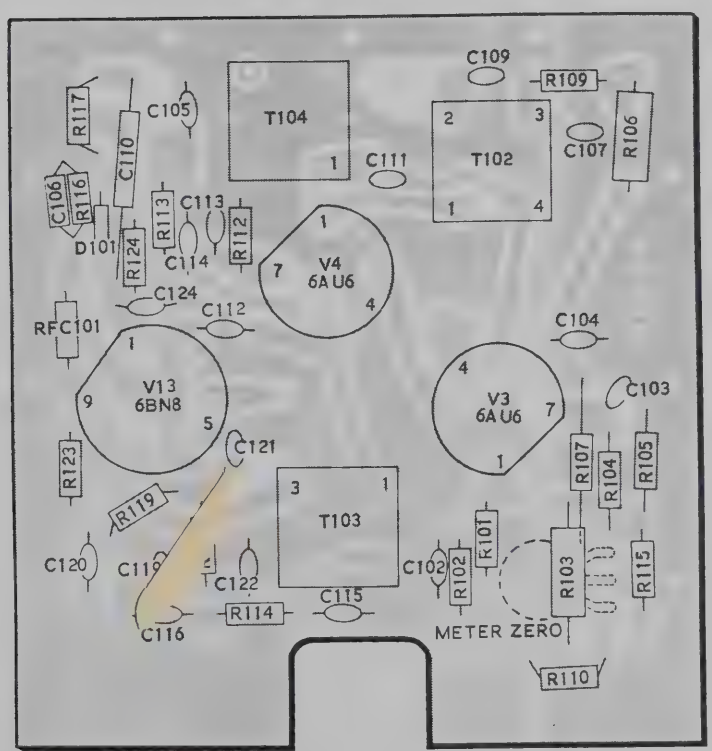
CRYSTAL CIRCUIT BOARD
#85-132P226



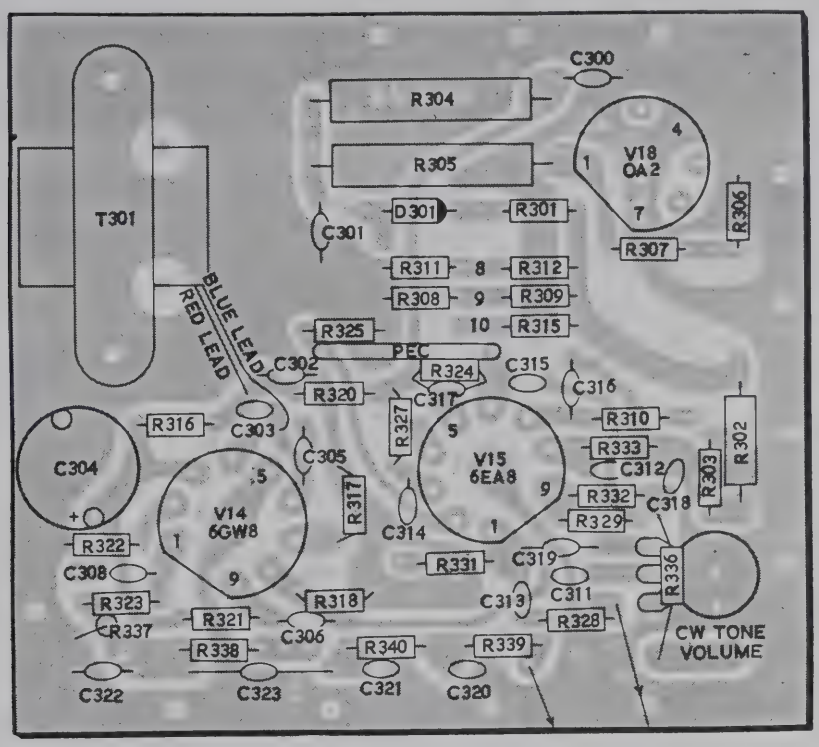
DRIVER GRID CIRCUIT BOARD
#85-133P228



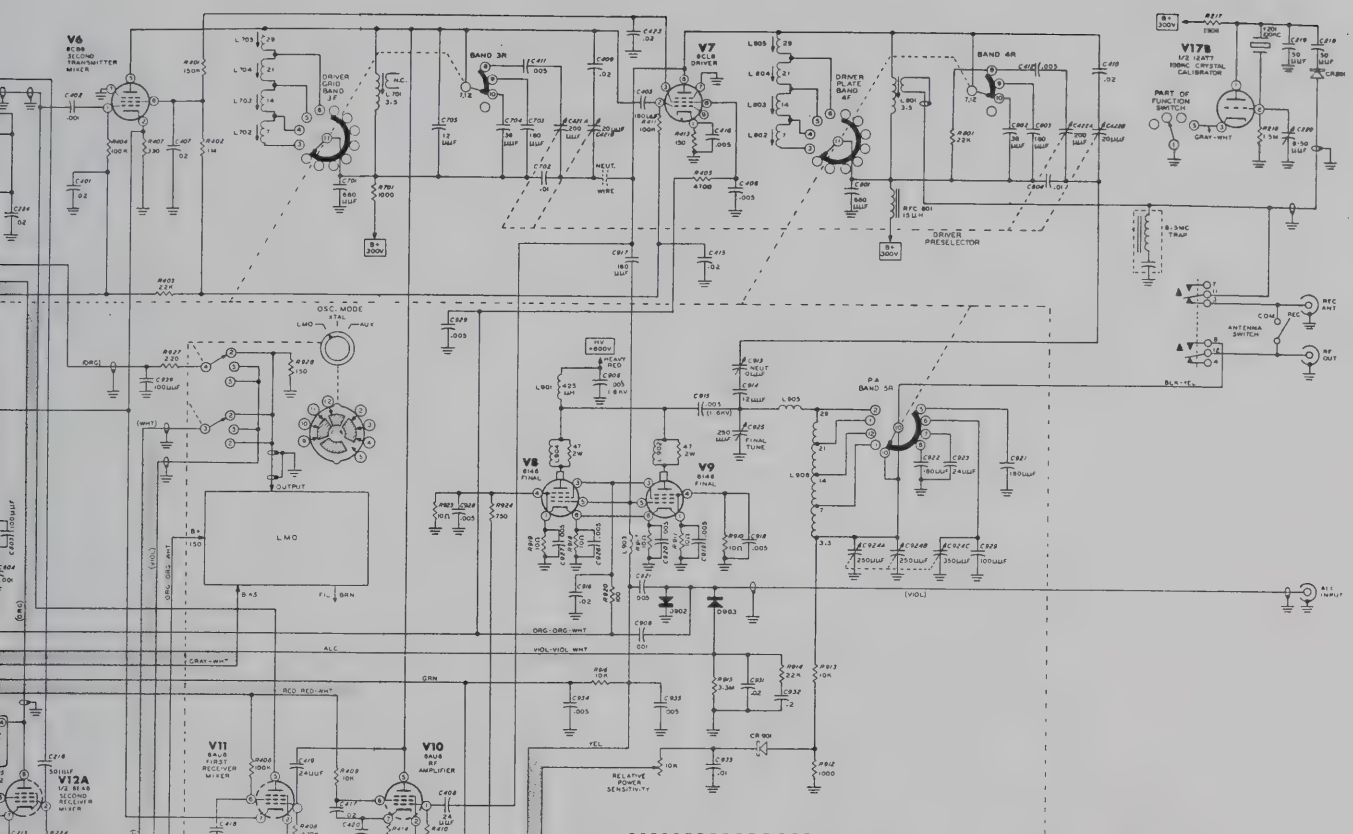
MODULATOR CIRCUIT BOARD
#85-127P221



IF CIRCUIT BOARD
#85-128P222



AUDIO CIRCUIT BOARD
#85-130P224



SCHEMATIC OF THE HEATHKIT® SSB TRANSCEIVER MODEL SB-100

NOTE

LETTER NUMBER DESIGNATIONS FOR RESISTORS, CAPACITORS, ETC., HAVE BEEN PLACED IN THE FOLLOWING GROUPS

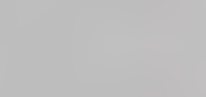
0- 99	PARTS ON MODULATOR CIRCUIT BOARD.	
100-199	" RF "	
200-299	" BANDPASS "	
300-399	" AU IIO "	
400-499	" RF-DRIVER "	
500-599	" CRYSTAL "	
600-699	" HETERODYNE OSCILLATOR "	
700-799	" DRIVER GRID "	
800-899	" DRIVER PLATE "	
900-999	PARTS MOUNTED ON THE CHASSIS.	

1. ALL RESISTORS ARE 1-2 WATT UNLESS MARKED OTHERWISE. ALL RESISTOR VALUES ARE IN OHMS - K = 1000, MEG = 1,000,000.
2. ALL CAPACITOR VALUES ARE IN MMFD UNLESS MARKED OTHERWISE.
3. REFER TO THE X-RAY AND CHASSIS VIEWS FOR PHYSICAL LOCATION OF PARTS
4. SEE VOLTAGE AND RESISTANCE CHARTS PAGES 00-00 FOR ALL MEASUREMENTS
5. ALL SWITCHES ARE IN THE POSITION INDICATED BY THE KNOB POINTERS.
6. ARROW () INDICATES CLOCKWISE ROTATION OF KNOB VIEWED FROM KNOB END.
7. [] INDICATES HOOKUP WIRE NOT IN THE HARNESS.
8. () INDICATES COLOR CODE OF COAXIAL CABLE
9. ALL RELAY CONTACTS SHOWN IN RECEIVE POSITION.

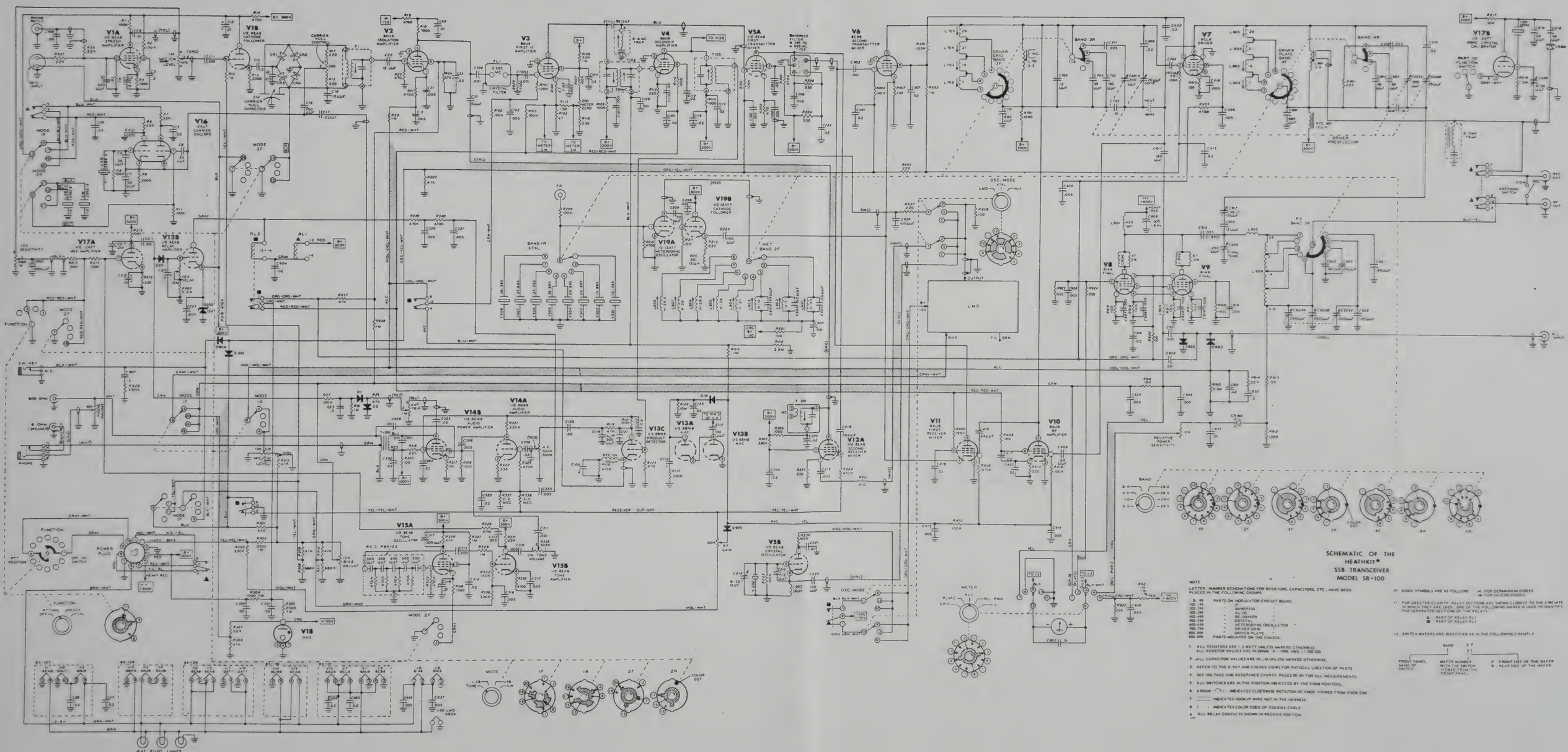
10 DIODE SYMBOLS ARE AS FOLLOWS ⇨ FOR GERMANIUM DIODES, ⊕ FOR SILICON DIODES.

11. FOR GREATER CLARITY, RELAY SECTIONS ARE SHOWN CLOSEST TO THE CIRCUITS IN WHICH THEY ARE USED. ONE OF THE FOLLOWING MARKS IS USED TO IDENTIFY THE SEPARATED SECTIONS OF THE RELAYS
 - ▲ - PART OF RELAY RL1
 - ■ PART OF RELAY RL2

12 SWITCH WAFERS ARE IDENTIFIED AS IN THE FOLLOWING EXAMPLE



SB-100



SCHEMATIC OF THE
HEATHKIT®
SSB TRANSCEIVER
MODEL SB-100

NOTE

LETTER NUMBER DESIGNATIONS FOR RESISTORS, CAPACITORS, ETC., HAVE BEEN PLACED IN THE FOLLOWING GROUPS

0- 99	PARTS ON MODULATOR CIRCUIT BOARD	
100- 199	-	BANDPASS
200- 299	-	ALC-MIC
300- 399	-	RF DRIVER
400- 499	-	CRYSTAL
500- 599	-	HETERODYNE OSCILLATOR
600- 699	-	DRIVER GRID
700- 799	-	DRIVER PLATE
800- 899	-	PA
900- 999	PARTS MOUNTED ON THE CHASSIS.	

1. ALL RESISTORS ARE 1/2 WATT UNLESS MARKED OTHERWISE.
 ALL RESISTOR VALUES ARE IN OHMS. K = 1000, MEG = 1,000,000
2. ALL CAPACITOR VALUES ARE IN μμF UNLESS MARKED OTHERWISE.
3. REFER TO THE X-RAY AND CHASSIS VIEWS FOR PHYSICAL LOCATION OF PARTS
4. SEE VOLTAGE AND RESISTANCE CHARTS, PAGES 00-00, FOR ALL MEASUREMENTS.
5. ALL SWITCHES ARE IN THE POSITION INDICATED BY THE KNOB POINTERS.
6. ARROW (↻) INDICATES CLOCKWISE ROTATION OF KNOB VIEWED FROM KNOB END
7. ——— INDICATES HOOK-UP WIRE NOT IN THE HARNESS.
8. | | INDICATES COLOR CODE OF COAXIAL CABLE
9. ALL RELAY CONTACTS SHOWN IN RECEIVE POSITION

10. DIODE SYMBOLS ARE AS FOLLOWS: ⇒ FOR GERMANIUM DIODES, ⊣ FOR SILICON DIODES

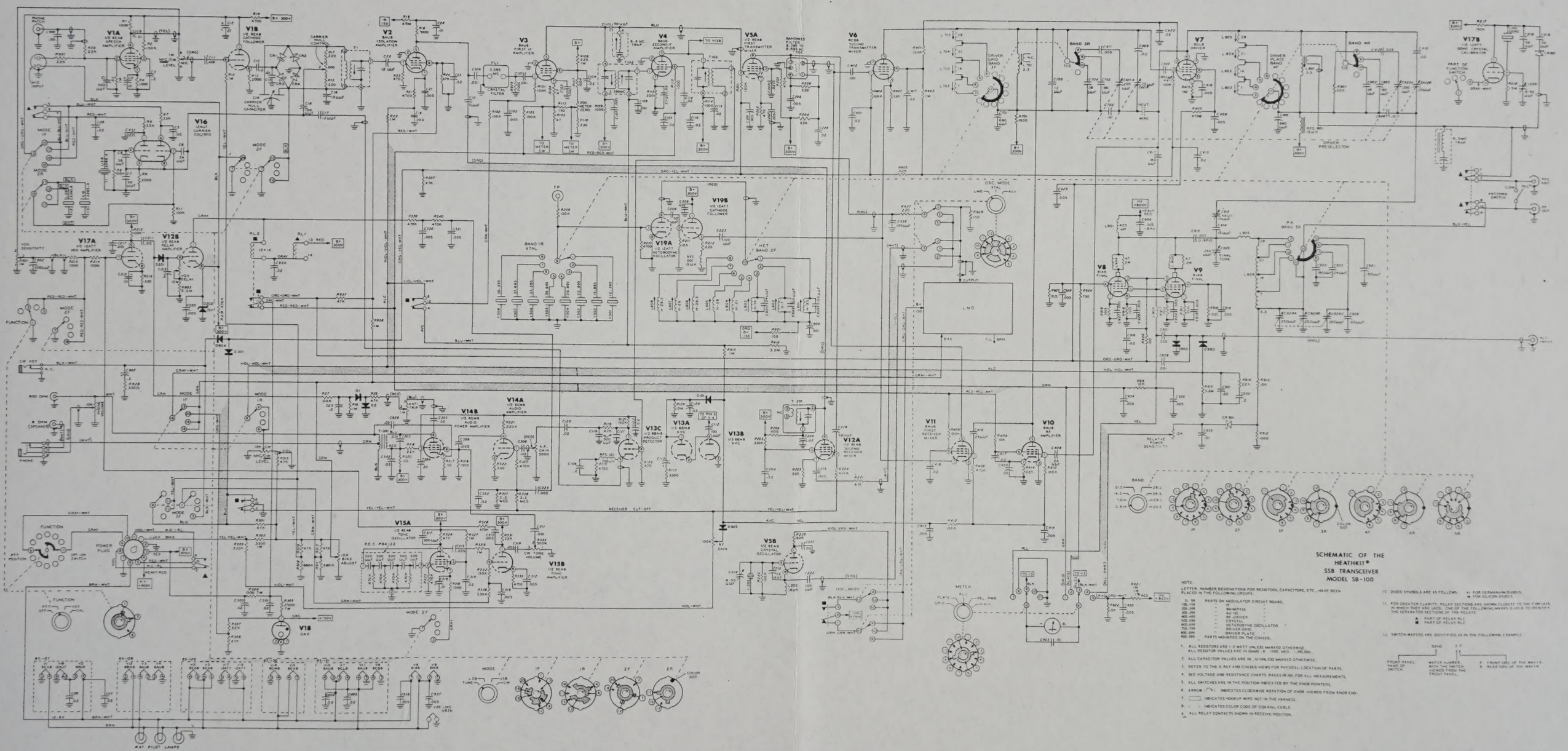
11. FOR GREATER CLARITY, RELAY SECTIONS ARE SHOWN CLOSEST TO THE CIRCUITS IN WHICH THEY ARE USED. ONE OF THE FOLLOWING MARKS IS USED TO IDENTIFY THE SEPARATED SECTIONS OF THE RELAYS
 ▲ PART OF RELAY RL1
 ■ PART OF RELAY RL2

12. SWITCH WAFERS ARE IDENTIFIED AS IN THE FOLLOWING EXAMPLE

BAND 2 F
1 1

FRONT PANEL NAME OF SWITCH — WAFER NUMBER WITH THE SWITCH MOTIONLESS FROM THE FRONT PANEL — F - FRONT SIDE OF THE WAFER, R - REAR SIDE OF THE WAFER

SB-100



NOTE:

LETTER-NUMBER DESIGNATIONS FOR RESISTORS, CAPACITORS, ETC., HAVE BEEN PLACED IN THE FOLLOWING GROUPS:

0- 99	PARTS ON MODULATOR CIRCUIT BOARD.
100-199	IF
200-299	BANDPASS
300-399	ALC-VOX
400-499	RF-DRIVER
500-599	CRYSTAL
600-699	HETERODYNE OSCILLATOR
700-799	DRIVER GRID
800-899	DRIVER PLATE
900-999	PARTS MOUNTED ON THE CHASSIS.

1. ALL RESISTORS ARE 1/2 WATT UNLESS MARKED OTHERWISE. ALL RESISTOR VALUES ARE IN OHMS (K - 1000, MEG - 1,000,000).
2. ALL CAPACITOR VALUES ARE IN MFD UNLESS MARKED OTHERWISE.
3. REFER TO THE X-RAY AND CHASSIS VIEWS FOR PHYSICAL LOCATION OF PARTS.
4. SEE VOLTAGE AND RESISTANCE CHARTS (PAGES 00-00) FOR ALL MEASUREMENTS.
5. ALL SWITCHES ARE IN THE POSITION INDICATED BY THE KNOB POINTERS.
6. ARROW (↻) INDICATES CLOCKWISE ROTATION OF KNOB VIEWED FROM KNOB END.
7. ▭ INDICATES HOOKUP WIRE NOT IN THE HARNESS.
8. ⊙ INDICATES COLOR CODE OF COAXIAL CABLE.
9. ALL RELAY CONTACTS SHOWN IN RECEIVE POSITION.

10. DIODE SYMBOLS ARE AS FOLLOWS: ⊣⊢ FOR GERMANIUM DIODES; ⊣▶⊢ FOR SILICON DIODES.

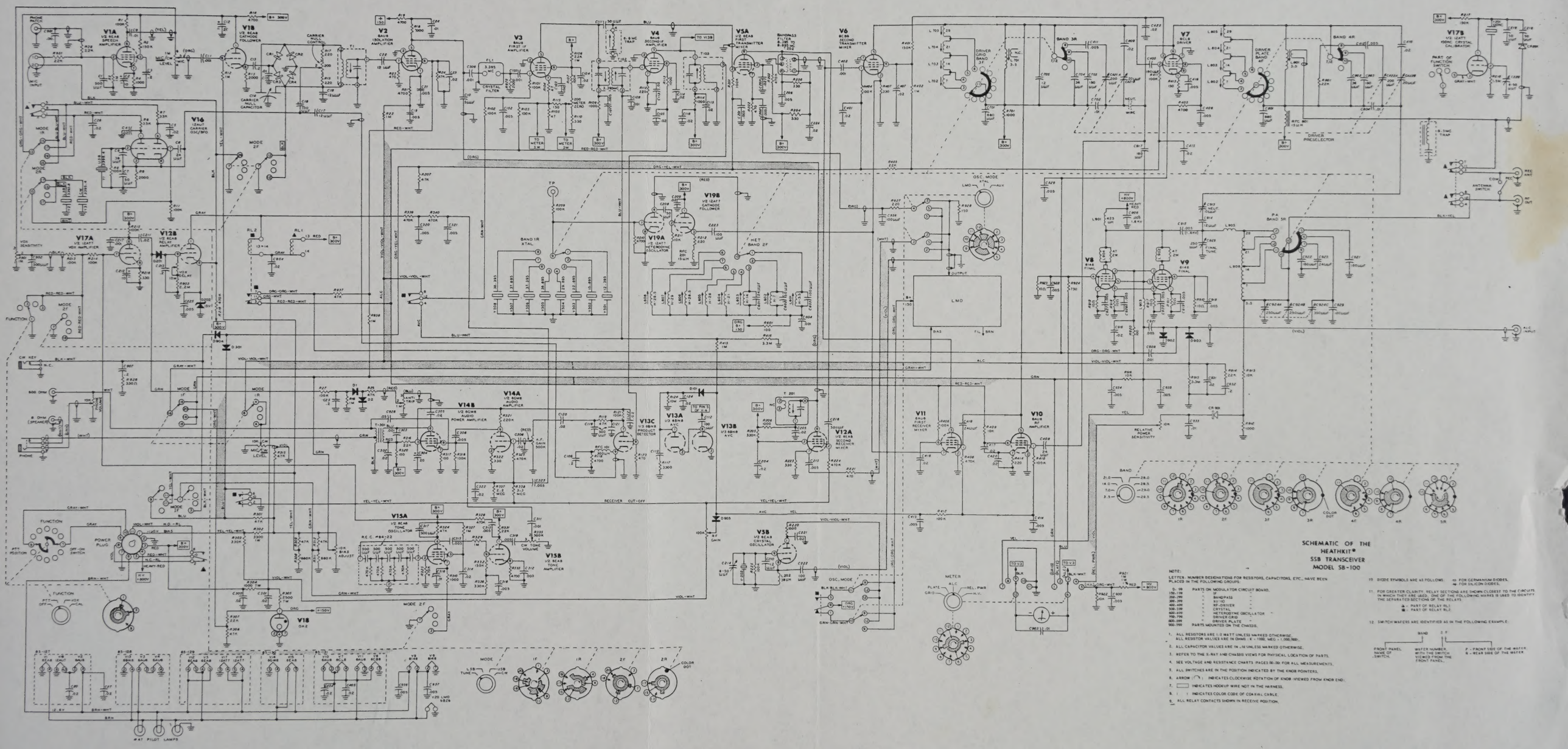
11. FOR GREATER CLARITY, RELAY SECTIONS ARE SHOWN CLOSEST TO THE CONTACTS TO WHICH THEY ARE USED. ONE OF THE FOLLOWING MARKS IS USED TO IDENTIFY THE SEPARATED SECTIONS OF THE RELAYS:
▲ PART OF RELAY RL1
■ PART OF RELAY RL2

12. SWITCH WAFERS ARE IDENTIFIED AS IN THE FOLLOWING EXAMPLE:

BAND 2 F

FRONT PANEL NAME OF SWITCH. — WAFER NUMBER WITH THE SWITCH VIEWED FROM THE FRONT PANEL. — F FRONT SIDE OF THE WAFER. R REAR SIDE OF THE WAFER.

SB-100



SCHEMATIC OF THE HEATHKIT® SSB TRANSCEIVER MODEL SB-100

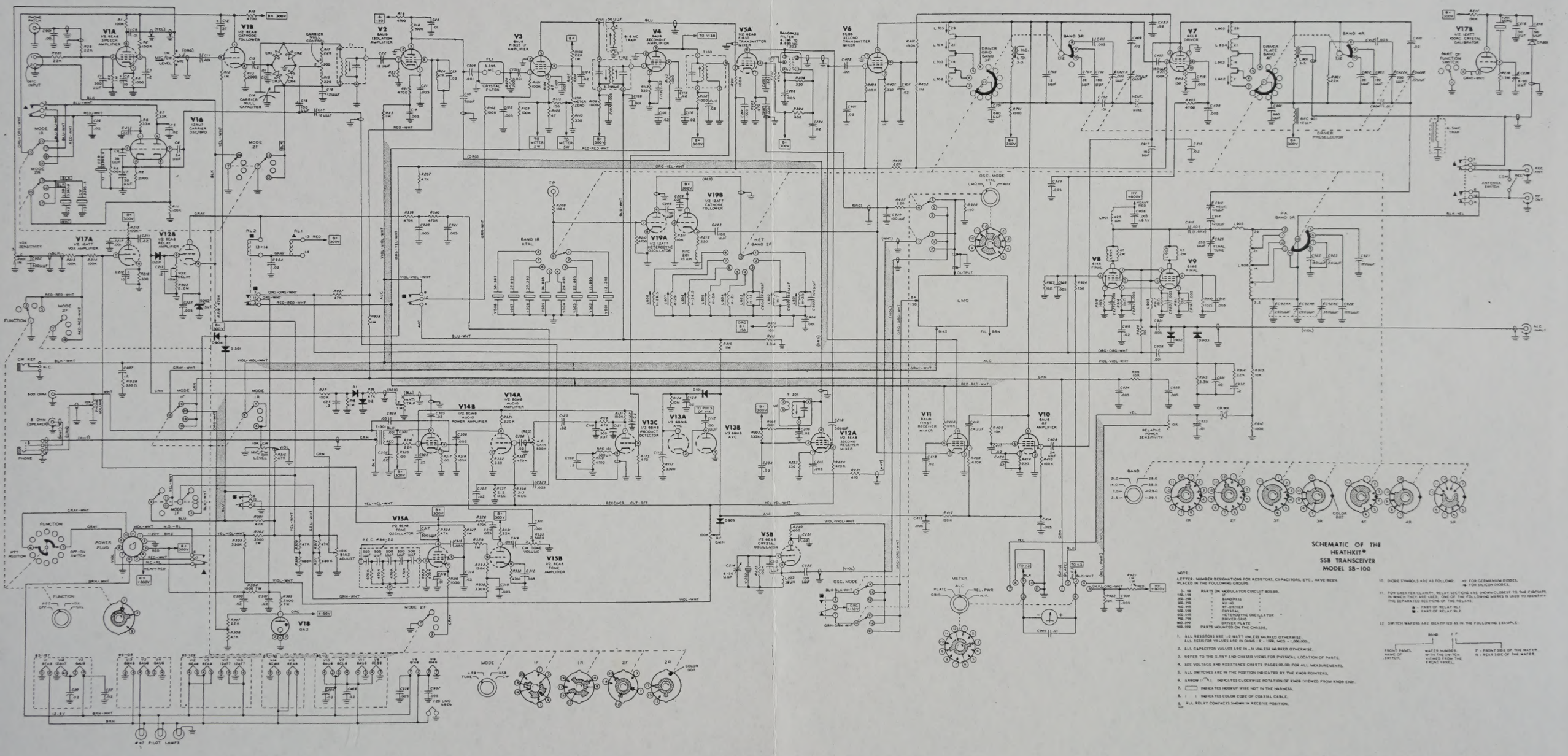
NOTE:

LETTER, NUMBER DESIGNATIONS FOR RESISTORS, CAPACITORS, ETC., HAVE BEEN PLACED IN THE FOLLOWING GROUPS:

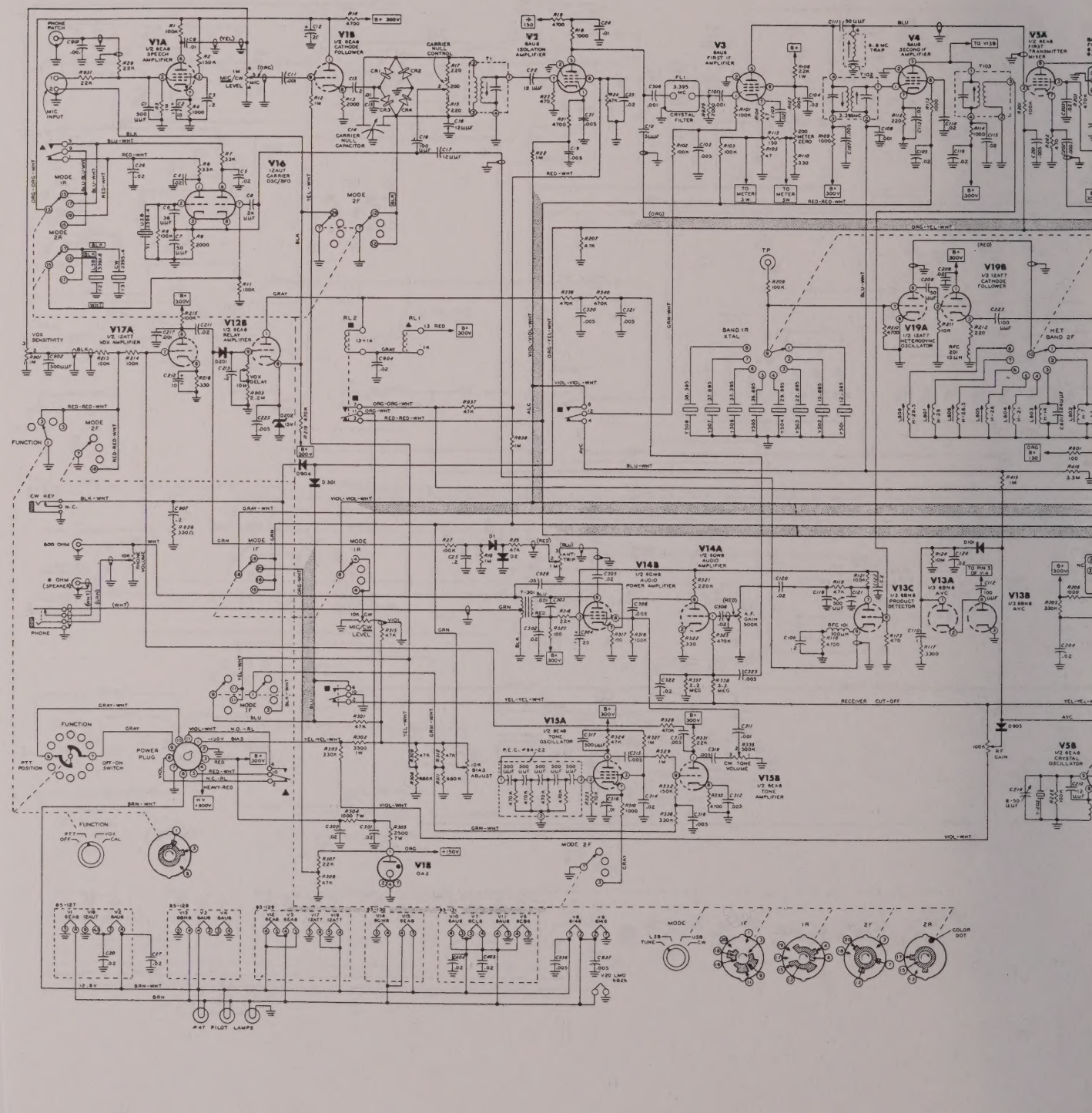
0-99	PARTS ON MODULATOR CIRCUIT BOARD.
100-199	" IF " "
200-299	" BANDPASS " "
300-399	" RF " "
400-499	" 1ST DRIVER " "
500-599	" CRYSTAL " "
600-699	" HETERODYNE OSCILLATOR " "
700-799	" DRIVER GRID " "
800-899	" DRIVER PLATE " "
900-999	PARTS MOUNTED ON THE CHASSIS.

1. ALL RESISTORS ARE 1/2 WATT UNLESS MARKED OTHERWISE. ALL RESISTOR VALUES ARE IN OHMS. K = 1000, MEG = 1,000,000.
2. ALL CAPACITOR VALUES ARE IN μf UNLESS MARKED OTHERWISE.
3. REFER TO THE X-RAY AND CHASSIS VIEWS FOR PHYSICAL LOCATION OF PARTS.
4. SEE VOLTAGE AND RESISTANCE CHARTS (PAGES 00-00) FOR ALL MEASUREMENTS.
5. ALL SWITCHES ARE IN THE POSITION INDICATED BY THE KNOB POINTERS.
6. ARROW (↻) INDICATES CLOCKWISE ROTATION OF KNOB VIEWED FROM KNOB END.
7. ▭ INDICATES HOOKUP WIRE NOT IN THE HARNESS.
8. () INDICATES COLOR CODE OF COAXIAL CABLE.
9. ALL RELAY CONTACTS SHOWN IN RECEIVE POSITION.
10. DIODE SYMBOLS ARE AS FOLLOWS: ⇨ FOR GERMANIUM DIODES, ⇒ FOR SILICON DIODES.
11. FOR GREATER CLARITY, RELAY SECTIONS ARE SHOWN CLOSEST TO THE CIRCUITS IN WHICH THEY ARE USED. ONE OF THE FOLLOWING MARKS IS USED TO IDENTIFY THE SEPARATED SECTIONS OF THE RELAYS:
 - ▲ = PART OF RELAY RL1
 - ■ = PART OF RELAY RL2
12. SWITCH WAFERS ARE IDENTIFIED AS IN THE FOLLOWING EXAMPLE:

5B-100


V1A
V1B
V2
V3
V4
V5A
V6
V7
V8
V9
V10
V11
V12A
V12B
V13A
V13B
V13C
V14A
V14B
V15A
V15B
V16
V17A
V17B
V18
V19A
V19B
V5B
MODE 1R
MODE 2R
MODE 1F
MODE 2F
FUNCTION
OSC. MODE
METER
BAND
COLOR DOT
SCHEMATIC OF THE
HEATHKIT®
SSB TRANSCEIVER
MODEL SB-100
NOTE:
LETTER-NUMBER DESIGNATIONS FOR RESISTORS, CAPACITORS, ETC., HAVE BEEN PLACED IN THE FOLLOWING GROUPS:
D- 99 PARTS ON MODULATOR CIRCUIT BOARD.
100-199 IF
200-299 BANDPASS
300-399 AF AMPLIFIER
400-499 RF AMPLIFIER
500-599 CRYSTAL
600-699 HETERODYNE OSCILLATOR
700-799 DRIVER GRID
800-899 DRIVER PLATE
900-999 PARTS MOUNTED ON THE CHASSIS.
1. ALL RESISTORS ARE 1/2 WATT UNLESS MARKED OTHERWISE. ALL RESISTOR VALUES ARE IN OHMS - K = 1000, MEG = 1,000,000.
2. ALL CAPACITOR VALUES ARE IN µµF UNLESS MARKED OTHERWISE.
3. REFER TO THE X-RAY AND CHASSIS VIEWS FOR PHYSICAL LOCATION OF PARTS.
4. SEE VOLTAGE AND RESISTANCE CHARTS (PAGES 00-00) FOR ALL MEASUREMENTS.
5. ALL SWITCHES ARE IN THE POSITION INDICATED BY THE KNOB POINTERS.
6. ARROW () INDICATES CLOCKWISE ROTATION OF KNOB VIEWED FROM KNOB END.
7. () INDICATES HOOKUP WIRE NOT IN THE HARNESS.
8. () INDICATES COLOR CODE OF COAXIAL CABLE.
9. ALL RELAY CONTACTS SHOWN IN RECEIVE POSITION.
10. DIODE SYMBOLS ARE AS FOLLOWS: ⊣⊢ FOR GERMANIUM DIODES, ⊣▸⊢ FOR SILICON DIODES.
11. FOR GREATER CLARITY, RELAY SECTIONS ARE SHOWN CLOSEST TO THE CIRCUITS IN WHICH THEY ARE USED. ONE OF THE FOLLOWING MARKS IS USED TO IDENTIFY THE SEPARATED SECTIONS OF THE RELAYS:
▲ - PART OF RELAY RL1
■ - PART OF RELAY RL2
12. SWITCH WAFERS ARE IDENTIFIED AS IN THE FOLLOWING EXAMPLE:
BAND 2 F
FRONT PANEL NAME OF SWITCH
WAFER NUMBER WITH THE SWITCH VIEWED FROM THE FRONT PANEL.
F - FRONT SIDE OF THE WAFER
R - REAR SIDE OF THE WAFER

SB-100


V1A
V1B
V2
V3
V4
V5A
V5B
V13A
V13B
V13C
V14A
V14B
V16
V17A
V17B
V18
V19A
V19B
MODE 1R
MODE 2R
MODE 2F
MODE 1F
FUNCTION
POWER PLUG
PHONE PATCH
MIC INPUT
CW KEY
800 OHM
8 OHM (SPEAKER)
PHONE
PTT POSITION
OFF-ON SWITCH
VOX SENSITIVITY
CARRIER NULL CONTROL
CARRIER NULL CAPACITOR
CRYSTAL FILTER
BAND 1R XTAL
MET BAND 2F
AUDIO VOLUME
MIC/CW LEVEL
VOX DELAY
A.F. GAIN
R.F. GAIN
CW TONE VOLUME
-130V BIAS
ADJUST
TO METER
TO V13B
TO PIN 5 OF V-4
#47 PILOT LAMPS
RECEIVER CUT-OFF